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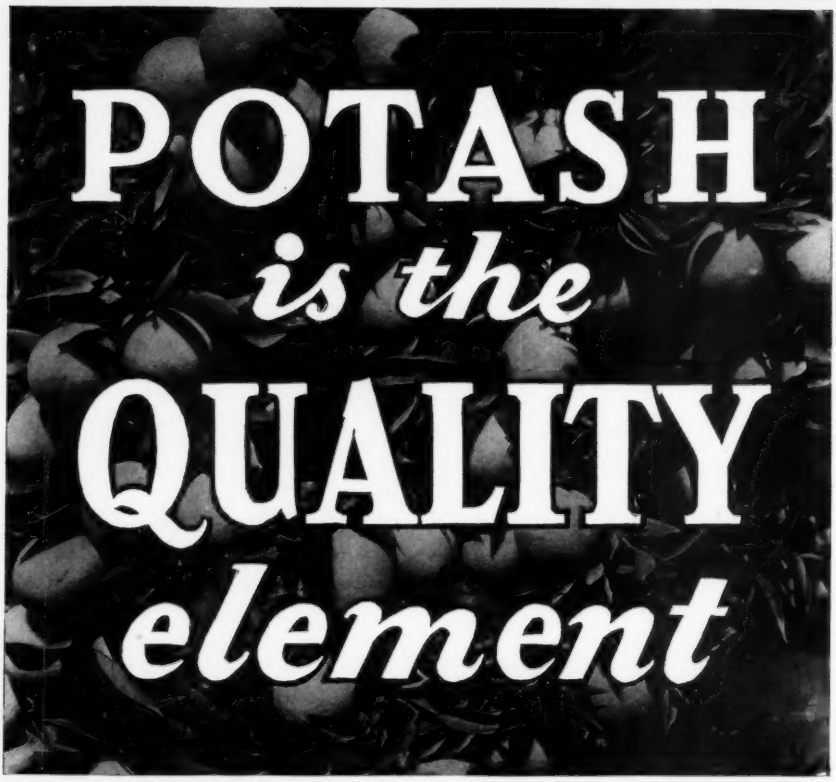

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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Managing Editor* SID NOBLE, *Editor*

Editorial Offices: 19 West 44th Street, New York

VOLUME XVIII NUMBER SIX

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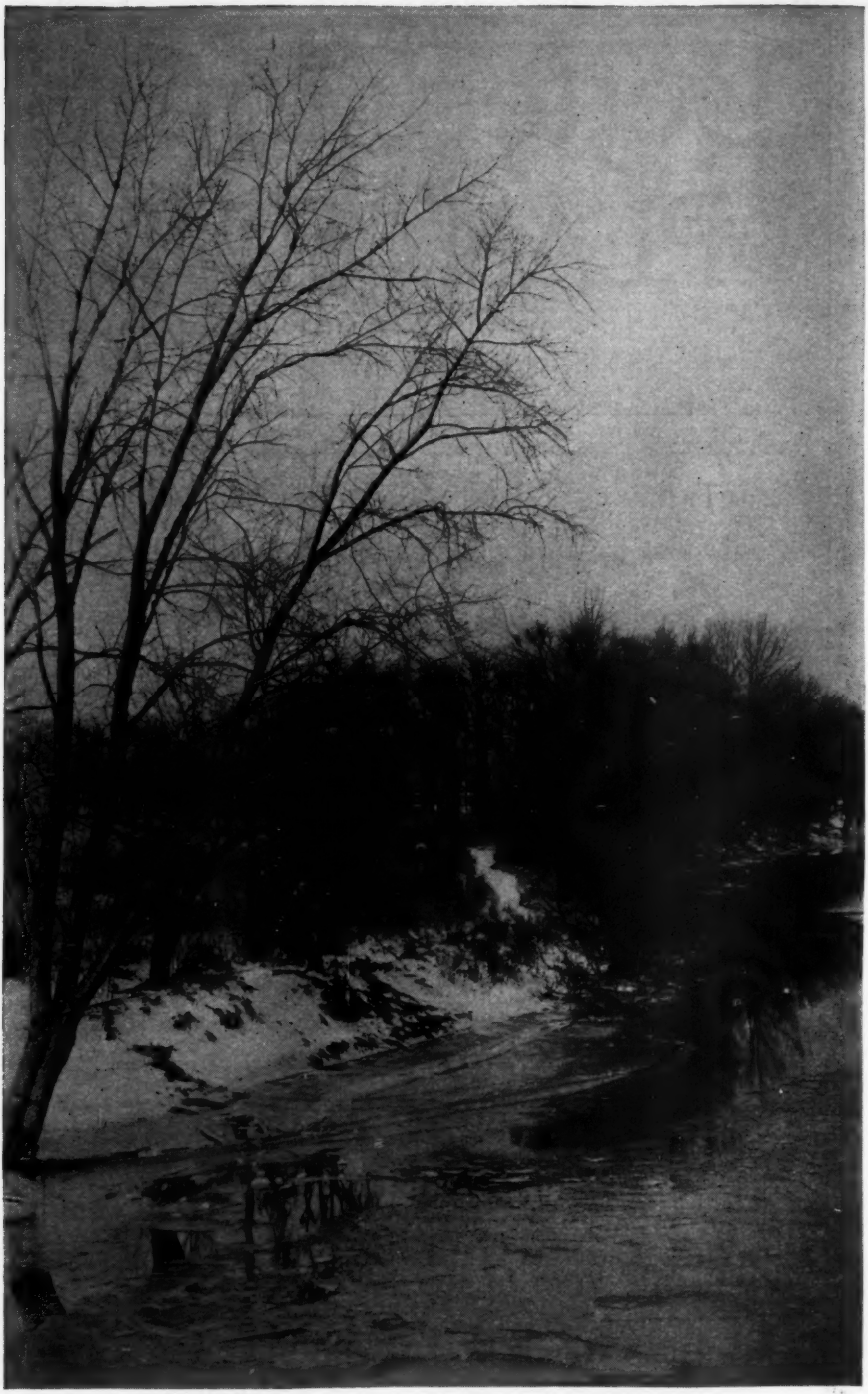

WINTER LOSES ITS GRIP

Better Crops with PLANT FOOD

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VOL. XVIII NEW YORK, FEB.-MAR., 1933 No. 6

"White man heap foolish," according to Indian Chief.

Nomads *and* Numskulls

By Jeff McDermid

THIS is a commentary on "High," the poor white man, "Lo," the poor Indian, and "Jack," the miserable medium of exchange; but the "Game" isn't over!

Your scribe perplexes himself with the obnoxious question—Shall agricultural science and progress submit to some "allotted" scheme of naked fallow and nomadic crop abortion, or have we the brains and the social engineering to get us out of a mess such as the red man never realized? It's a highly fertile subject with considerable manurial value.

Egotistical white races have swelled their chests over the vast improvement they have made upon American food and fiber crops, of which 70 per cent of the species were presented to us gratis by the untutored "dirt" (and grease) farmers of aboriginal tribes. We found the savage belle smoking a peace-pipe, and eventually we turned the leaf into a cute kiss-proof pack-

age for her ladyship, plus profits and stamp taxes. We found him using hemp in fishing and basketry, and we changed it into cord tires for rich criminals and halter rope for the poor ones. The Hopi gave us the cotton plant, and we are hoping about it yet. If the Kickapoo invented the potato, we passed it on to kick and pooh pooh over. The Indian domesticated many things for us, from asparagus to yams, and now they seem wilder than ever in the w. k. "crop outlook." And as for the corn plant, the Indian at least got simon-pure fire water in the deal and left us perplexed with bootleg Bourbon and more cobs than cash.

PAUL WEATHERWAX is quoted to start our present discussion. In his Story of the Maize Plant he says, "There was found in certain parts of aboriginal America a condition in which, although work was necessary for a comfortable living, yet intelligent action was rewarded with much leisure. The key to this was Indian corn. Only a few favored spots in America supported races that approached a condition of civilization, and these were the localities where fixed habitations and relief from constant physical effort were possible through the cultivation of maize."

Early explorers found the Indians cultivating it. Columbus in his letters to Spain mentions corn fields 18 miles in length. Some of the greatest engineering feats of aboriginal times were the Indian garden beds, or old corn fields in the Midwest. These remains are found today in the Mississippi valley, showing that the Mound Builders who made them planted corn in single and double rows in parallel or curved ridges. This particular race was of a higher state of culture than the original tribesmen who were nomadic rovers, who abandoned corn land when it lost fertility. The more settled tribes indicated their upward march to civilization by restoring soil fertility by means of fish, guano, and wood ashes.

Nobody knows definitely whether the Indian farmer was concerned with any surplus production problems, although we know he had large storehouses for corn. In the absence of any bureau of Indian corn estimates, we are unable to enlighten you with the rate of his yield, but an historical authority tells me that in the upper Mississippi valley corn lands in the seventeenth century there were probably 250,000 red people. We know for sure that the Jamestown colony took lessons in corn culture from the Indians and did so well under their method of husbandry that 20 years after the settlement, or in 1640, the colony had surplus corn for export—and strange to say, the surplus tickled them.

Little as we know about the forest corn lands, we began to get more facts when the French missionaries penetrated the interior. Just about 300 years ago Henry de Tonty, a lieutenant of LaSalle's, was driven north of Kaskaskia, Illinois, by the hostile Indians and wandered around with his men in a starving and miserable condition for several weeks. By accident they stumbled into an old Pottawatomie village and one of their number uncovered a cache of glorious golden corn. It saved the band from death and marked one of the first instances where white men owed their existence to a surplus of native food crops.

BY way of sharp and interesting contrast, Bill Thomas of Kaskaskia, Illinois, in the year 1932, in a supposedly civilized and advanced nation, stokes his underfed furnace with great shovelfuls of Reid Yellow Dent (bred for high yield and resistant to Diplodia) simply because it is cheaper to get British thermal units out of his corn than to shell it, haul it to market for 15 cents a bushel, and bring back coal at $6 a ton. When the kernels

(*Turn to page* 61)

Following Sweet Clover Potash Increases Corn Yields

By O. H. Sears

Soil Biologist, Department of Agronomy, University of Illinois

IT was believed formerly that most Illinois soils contained sufficient potassium for future needs of maximum crop production, and that the potash problem could be solved by liberating potassium through the use of sweet clover as a green-manuring crop. Contrary to this belief, it is now apparent that the repeated growing of sweet clover may increase rather than decrease the need for potash on many Illinois soils. Results of field experiments and farm practice indicate that instead of sweet clover being the key which unlocks nature's storehouse for potassium, sweet clover needs potash as a balance wheel.

The corn crop on the 100 series on the soil experiment field located at Ewing was the first to show this condition in Illinois. Since the establishment of this field in 1910, the rota-

This is the appearance of the corn on the Ewing Experiment Field after the third crop of sweet clover had been plowed under. On the left the soil treatment was limestone, rock phosphate, sweet clover; on the right, the treatment was limestone, rock phosphate, sweet clover, plus potash.

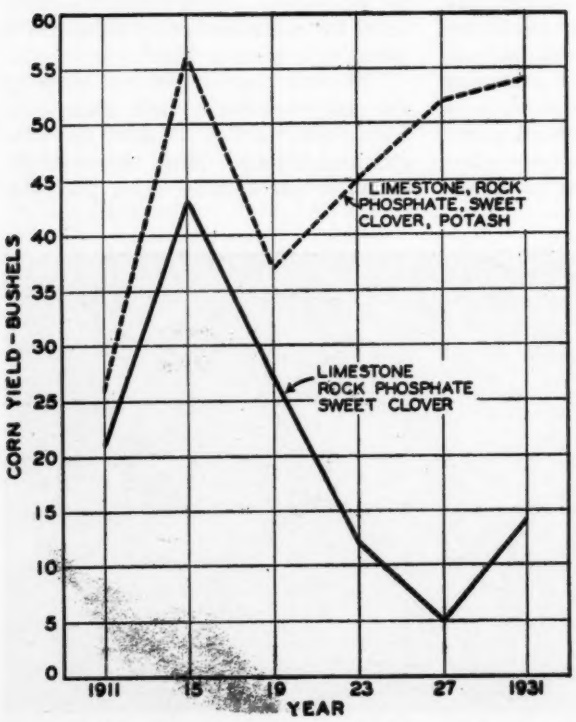
EFFECT OF SOIL TREATMENT UPON CORN YIELDS ON EWING EXPERIMENT FIELD

Plot No.	Soil Treatment	1911	1915	1919	1923	1927	1931
105	None	13	18	9	16	20	18
107	Limestone-Sweet clover	23	47	28	13	5	9
108	Limestone-Rock phosphate-Sweet clover	21	43	27	12	5	14
109	Limestone-Rock phosphate-Sweet clover-Kainit	26	56	37	45	52	54
	Gain for potash	5	13	10	23	47	40

tion has consisted of corn, oats, clover, and wheat, with a sweet-clover, green-manure crop seeded in the wheat. In addition, cowpeas were sown in the corn at the last cultivation until 1920. In 1921 sweet clover was substituted for the clover, and in 1922 the return of wheat straw was discontinued.

Corn yields on this field have been increased by potash applications from the beginning and the gains have been more pronounced with each succeeding rotation. This fact is shown in the table above.

Two results are quite apparent. The plot receiving potash applications in addition to limestone, rock phosphate, and sweet clover has produced rather uniform and relatively high yields of corn. On plots receiving the same basic treatment but with no potash, the soil treatment produced a marked benefit in the beginning; but during the last three rotations, the yields of corn have rapidly declined to a point below that of the untreated land. As a result of decreasing yields on one hand and increasing yields on the other hand, the advantage for potash has become more pronounced with each succeeding rotation.



The yields from Plots 108 and 109 on the Ewing Experiment Field show the effects of the rapid depletion of potash when only limestone, rock phosphate, and sweet clover were used from 1915 to 1931.

It is natural to ask why such a situation should exist. A few observations in connection with these results as well as experiences of some Illinois farmers are illuminating. The greatest decline in yields on Plot 8 occurred after (a) 4½ tons of limestone had

(*Turn to page 55*)

Fertilization *and* Care *of the* Citrus Grove

By J. L. Baskin

Orlando, Florida

HOW best to fertilize a citrus grove is a very real problem to some 17,000 owners and operators who make up the Florida citrus industry. These individuals, caretakers, companies, and corporations all strive for the same objective results. By results we mean a fair return on the investment after all operating costs have been deducted. Those growers who have bought land, cleared it, and planted citrus recognize that there must be from four to five years of expenditures before the grove will produce sufficient fruit to pay operating costs, to say nothing of return on investment. However, it is only fair to state that once the grove gets on a paying basis, it will rapidly expand its bearing surface and capacity to bear larger and better crops year after year, provided it receives proper fertilization and care.

Proper Fertilization and Care

Under this heading volumes have been written, and yet no grower has found a sure and open road to success. Conditions are always changing and there is a great deal of difference between theory and practice. Just as the theory of finance is helpful in conducting a bank or loan company, so the theory of fertilizing and caretaking is valuable to practical citrus growers. So valuable is the theory of plant growth, development, and maturity that even the most unlearned, practical grower must keep within its sphere if success is to be achieved. If we knew nothing of the theory, it would be impossible to properly and accurately accredit such results as are obtained.

Study Successful Groves

How often have you heard the expression "Nothing succeeds like success," or "You can't argue against success."

Whether consciously or unconsciously, successful citrus growers are bringing together the elements and forces that go to make success. Particularly is this true if a grower has consistently produced a satisfactory volume of quality fruit over a long period of years at a reasonable cost per box. Such a grower has yearly increased the bearing surface of his trees. If he drives too hard in this direction, he gets growth at the expense of fruit. Such fruit as he gets is coarse and rough. Where growth is taking place rapidly as a result of liberal nitrogen absorption from fertilizer or soil sources such as decaying organic matter, the storage of plant foods necessary to fruit bud differentiation is held in check. The result is a small crop. On account of the small crop, each fruit is over-fed on nitrogen, the principal growth element, and frequently becomes coarse.

Such conditions may be observed in any young grove that is being heavily fertilized with nitrogen. Here the object is to increase bearing surface.

To observe this vegetative condition of a young grove, know its cause and the sources of nitrogen that are most likely to bring it about, are most helpful in making the necessary correction. In making the correction, frequently both the kind and amount of nitrogen are changed. Readily soluble nitrogen is apt to give a coarser textured fruit or wood than the more slowly available organic source of nitrogen, provided the tree is in position to absorb it rapidly and expand growth in a like manner.

Change of Objective

After a grove has reached an age where fruit, rather than growth, is the objective, the fertilizing practice is varied to bring about this desired result. This does not mean that the grower must check growth too rapidly, for yearly expansion of the bearing surface is desirable. If the trees can be brought into heavy fruiting, the heavy drain will automatically hold growth within reasonable limits. Heavy fruiting also changes the physical appearance of a tree, opening up the top and causing outer branches to bend outward and downward.

Many growers fail to obtain heavy production the fourth and fifth year only because they keep their trees too vegetative, a condition which is not conducive to heavy fruiting.

Once a grove is in heavy fruiting, it becomes a matter of maintaining the proper ratio between the vegetative and the fruiting tendency of the tree. These two functions will move along together and the grove will thrive and profits will accrue to the owner until one of these factors out-distances the other. Then what happens? It has already been mentioned what happens if the grove becomes too vegetative —a small crop of coarse, rough fruit for one or more years. Where trees are vegetative, the nitrogen should be limited, and both the phosphoric acid and the potash increased. This will slow down growth and give the trees a longer dormant period which is necessary for the proper storage and transportation of materials for fruit bud differentiation. Potash, being the carrier of carbohydrates, is very necessary to fruit bud differentiation, which in turn is dependent upon the ratios of plant foods stored near where the new flush of growth is to appear.

One of the greatest secrets of proper grove management is to maintain a proper balance between the growing, or vegetative tendency of the tree, and the fruiting, or profit-producing tendency of the tree. It is a hard job for trees bearing a heavy crop to produce a full crop the following year. The wise grove owner anticipates the heavy drain of a big crop and starts early to supply the plant food to develop and mature his present crop and provide sufficient plant foods for storing, so that his trees will not become

(*Turn to page 55*)

A four-year-old Pineapple orange budded on rough lemon.

This exhibit of BARLEY won the
GOLD MEDAL MALTING SPECIAL
D. L. Scott, City View, Ontario
Cash Prize $500
and valuable Gold Medal

Luck *or* Sense

By E. K. Hampson

Hamilton, Ontario

Left: Mr. D. L. Scott of City View, Ontario, Champion Barley Grower of Canada.

"LUCKY D. L." That's what many of D. L. Scott's friends said when he won the Five Hundred Dollar Prize at the Royal Winter Fair at Toronto for the best 100 pounds of Malting Barley in Canada. Well, "D. L." was not disposed to argue the point since he already had the Five Hundred Dollar cheque in his pocket and really felt pretty lucky in winning it.

But after all "luck" had little or nothing to do with this wonderful achievement. D. L. Scott of Ottawa has been a producer of high-class seed grain for some years. He is a past master in the art of selecting, grading, and preparing grain for show; and he knows how to produce it as well.

"The best is none too good." That is how D. L. expresses his conviction with regard to the seed he sows on his farm. In 1929 he purchased one bushel of Elite Seed Barley of the O.A.C. No. 21 Variety. In Canada this represents the highest possible standard from a standpoint of purity of variety and strain.

This was sown on one and one-half acres of land. This, of course, is much less than the usual rate of seeding per acre. From this bushel of Elite stock he reaped slightly more than 75 bushels of registered, first generation barley; and from the product of this barley, the winning 100 pounds were selected in 1932.

But this is not all the story. D. L. is just as firm a believer in good soil as in good seed and puts his convictions to work.

After plowing down a field of stubble, he manured the land in the winter, worked up a deep mellow seedbed in the spring, and when sowing the barley drilled in at the same time 250 pounds per acre of a 2-10-10 fertilizer. Mr. Scott's opinion is that manure, of which he has an abundance as he is primarily a dairy farmer, is not enough and he consistently uses a fertilizer high in potash and phosphorus. This, Mr. Scott believes, strengthens the straw, fills out the barley kernels better, and hastens maturity.

Usually an alfalfa sod is turned under preceding a cereal crop on D. L's farm and in such cases a fertilizer containing no nitrogen is used. A favorite formula is 0-12-15.

Yes, D. L. Scott may be a believer in luck, but he knows that "luck" doesn't pay the taxes nor does it produce prize-winning barley.

Potash Starvation *in the* Greenhouse

By I. C. Hoffman

Assistant Horticulturist, Ohio Agricultural Experiment Station

GREENHOUSE vegetable growing is one of the most intensive types of agriculture ever devised, for in greenhouses one has practical control over the growth factors of heat, air, moisture, mineral nutrients, and to a certain extent light. As a result, the managers of modern greenhouses are able to obtain very large yields of the two principal crops—tomatoes and cucumbers.

Two crops of tomatoes or cucumbers, or one of each, are produced each year. It is no longer uncommon for yields of a single crop to be obtained in excess of 50 tons of ripe marketable tomatoes per acre. The green vines which produce these fruits aggregate approximately 25 tons an acre. Two such crops are produced annually which, therefore, aggregate 100 tons of ripe fruit and 50 tons of vines (leaves, stems, etc.) per acre under best greenhouse management. Similar weights also are obtained for the cucumber crops.

In producing these huge quantities of fruits and vines, the plants remove large amounts of minerals from the soil. In terms of the three principal fertilizer elements, they remove annually 1,100 pounds of nitrogen, 340 pounds of phosphoric acid, and 1,600 pounds of potash an acre. In order to replace these elements and return the soil to its original state of fertility, an average acre treatment is 40 tons of moderately rotted, unleached manure, carrying approximately 400 pounds of nitrogen, 200 pounds of phosphoric acid, and 400 pounds of potash, plowed into the soil. This is followed by

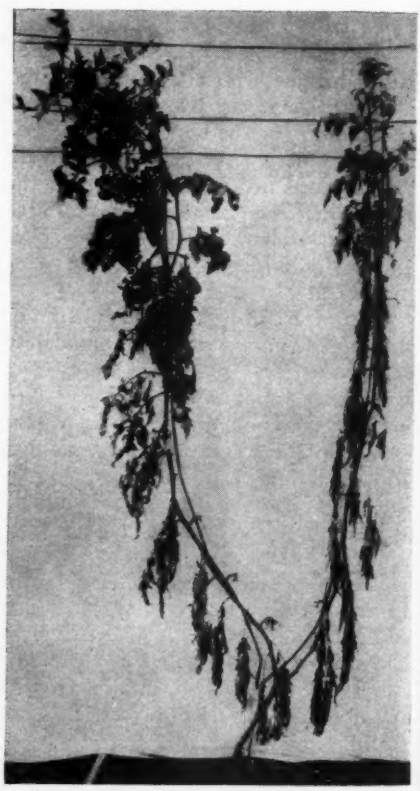


Fig. 1—A mature greenhouse tomato plant showing dead and chlorotic leaves at the base of the plant and green leaves at the top, as a result of potash starvation.

3,500 pounds of ammonium sulfate (or 4,650 pounds of nitrate of soda), 700 pounds of 20 per cent superphosphate, and 2,400 pounds of muriate or sulfate of potash to make up the balance.

The manure is applied at a single application, usually preceding the autumn crop, and the chemical fertilizers are divided between the two crops. These quantities of fertilizers may not be sufficient to produce maximum yields, since clay soil and finely decomposed organic matter absorb considerable quantities of ammonia and potassium. Also if the soil is neutral or alkaline, much of the phosphate is precipitated in the soil as insoluble compounds which in time may become largely unavailable to the plants.

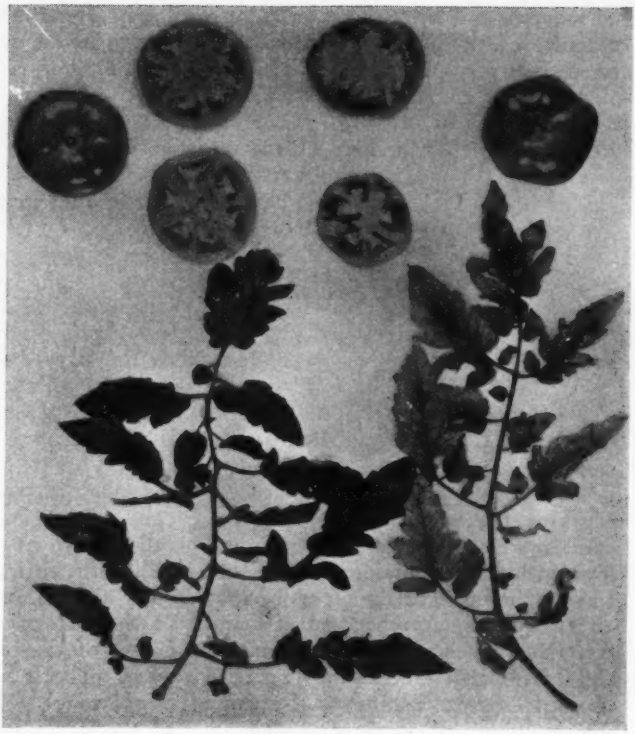


Fig. 2—Healthy tomato leaf and fruit (left); potash-starved leaf and fruit (right). Note the hollow, irregularly ripened fruit from the potash-starved plant. The leaves are yellowed, with greenish-tinted veins.

Need Plenty of Minerals

Tomatoes and cucumbers are "luxury consumers" of mineral nutrients and grow the best when there is an abundance of readily available minerals present. Hence it is often to the producer's advantage to supply from 10 to 25 per cent excess of the above fertilizers to allow for those quantities absorbed by the soil or leached from it into the drainage water. When any of these minerals are not present in sufficient quantity to provide for minimum growth, deficiency symptoms develop which become more pronounced as the plants become older.

Much interest is now being manifested by the greenhouse vegetable growers in the symptoms of potash deficiency, and some study of these symptoms is being made in the Ohio Agricultural Experiment Station greenhouses by the writer. Deficiency symptoms may start to appear in a plant at any age after the effect of that quantity of potassium which is contained in the seed has passed. There is enough potassium in well-developed tomato and cucumber seeds to provide for seedling growth until true leaves and secondary roots are formed, after which the plants must depend upon the soil for additional supplies. If the supply of available potassium becomes too low at any subsequent stage of the plant's development, there is a modification of its growth which in time affects its outward appearance. In the earliest stages the symptoms of potash de-

ficiency, as shown by the external appearance of the plant, might be confused with symptoms of deficiencies of certain other nutrients. When the symptoms have advanced to more acute stages, they become characteristic for potash and are unmistakable.

It is believed by plant physiologists that potassium does not combine with the plant tissue but remains largely dissolved in the sap and is easily transported throughout the plant. The first symptom of potash deficiency exhibited by the plant is a general slowing up in growth. This will continue and produce a stunted appearance in time. The color of the plant may become darker at first and then tend to become dull or ashen gray toward the edges of the leaves. The plants become more susceptible to disease, and low yields are obtained. The old leaves at the base of the plants become affected first. As they collapse and die, the potassium moves out during the dehydration process and is carried upward. Hence, the tops of the plants remain green and continue to elongate slowly after the leaves at the base have died. (See Figure 1.) The leaves do not fall, but remain attached to the stem.

The symptoms of potash deficiency in the leaves of tomatoes and cucumbers are progressive in their development. In young leaves, when ample nitrogen is present, the leaf blade is often finely crinkled between the veins, and in tomatoes the edges are usually curved downward and inward, forming a partially rolled condition. As the leaves become older and somewhat larger, they tend to flatten. In a short time the margins of the leaves turn ashen gray and then yellowish in color. Small, brown spots appear in the margins. These spots later become larger, unite, and form what is called "brown edge scorch," finally killing the entire margin. A brownish color appears mixed through the green in the web of the leaves, giving the center of the blades a bronze appearance. The leaves soon become harsh to the touch and brittle. The petioles of the leaves also are brittle and snap off cleanly with a light upward pressure.

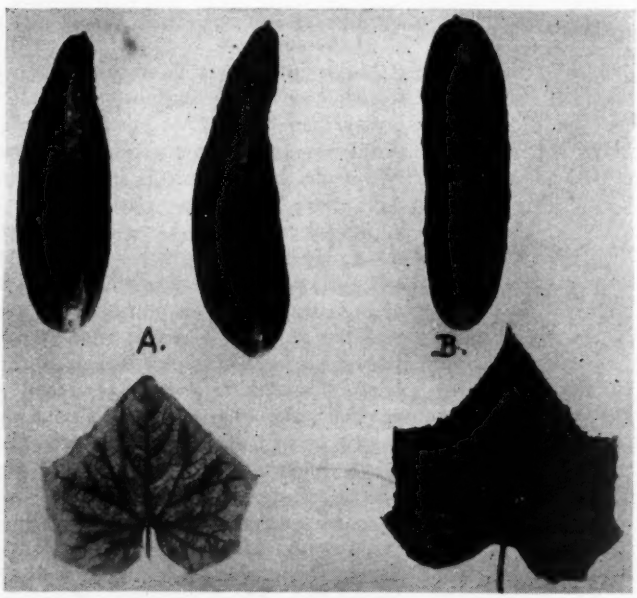
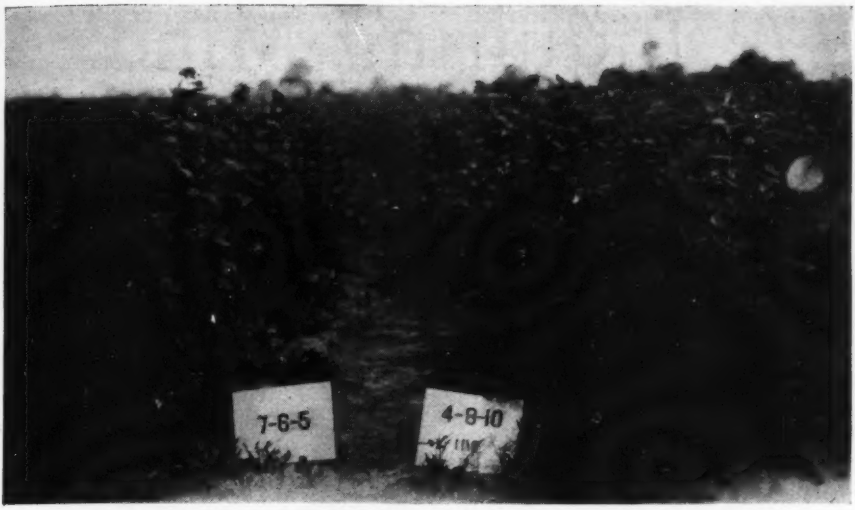


Fig. 3—Leaf and fruit A—from a potash-starved cucumber plant; B—from a healthy plant. The undeveloped stem end of fruit is characteristic of potash starvation.

Potash deficiency affects the cambium layer in the roots and stems. This layer becomes inactive, and the stems and roots fail to increase in diameter. As the potassium is moved up to the growing tips from the older parts of the plant, these cells continue to divide and the stems and roots continue to elongate, but remain thin and "stringy." Brown streaks, which

(*Turn to p.* 60)



High potash and lime increased the general vigor and growth of the canes.

Better Raspberries

By George R. Cobb

Salisbury, Maryland

HEAVY losses are incurred each year by raspberry growers due to a "dying back" of the canes, either partially or completely. The cause of this "disease" is still a debatable question, with one group of plant pathologists designating it as a "virus disease" and another group classifying it as a "physiological trouble."

And yet "there is now important evidence to show that a deficiency of potash may indirectly contribute largely to the causes leading up to die-back in fruit trees," according to Briton Jones. Research work being conducted at Long Ashton, England, by Mr. Jones shows that "there are considerably more fibrous roots produced by plants growing in nutrient media containing potash than are produced by those grown in media deficient in potash salts—thus not enough roots develop in gravelly soil deficient in potash to absorb sufficient moisture from a soil which is liable to dry out in summer."

If die-back in fruit trees is caused by lack of potash, it seems that the same condition may cause die-back in raspberries. With this thought in mind, tests or demonstrations were conducted on the farm of George F. Insley, Bivalve, Maryland, who is an extensive grower of red raspberries and other brambles.

These tests had a two-fold purpose —(1) to ascertain the effect, if any, potash might have on the die-back, and (2) to compare a high and low

(*Turn to page 56*)

The Inquiring Mind *and the* Seeing Eye

By Dr. A. S. Alexander

University of Wisconsin

WE are doffing our hats this month to Frank Duane Gardner, Professor of Agronomy at Pennsylvania State College, who richly deserves our respectful salutation and consideration for his many years of practical and scientific service in the cause of agriculture.

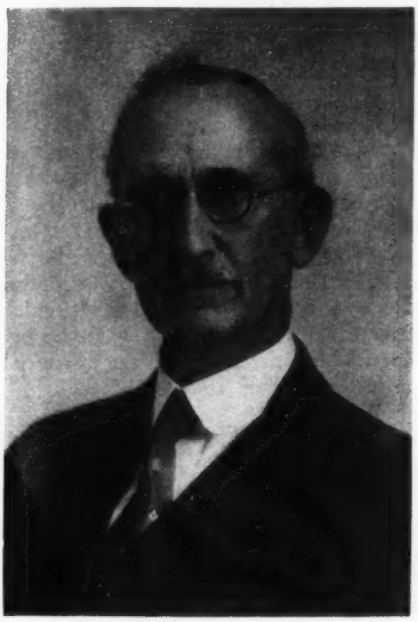
F. D. Gardner was born on a farm at Gilman, Illinois, on November 19, 1864, the son of Isaac J. Gardner and Iverno Bennett. Like the writer, he saw the unbroken, rolling prairie stretching from horizon to horizon, as he learned his first lessons in the art of farming. Those were the pioneer days in which the virgin, grass-covered prairies had to be subdued for the production of food for the settlers and their livestock. As he bravely steered the great breaking plow, which turned a shallow furrow 14 inches wide and laid the long ribbons of soil flat on the surface to be seeded to flax, the bobolinks warbled as they swung on the rosin-weeds or hovered singing in the air, and as far as the eye could reach waved the wild grasses, checkered in patches or pink and blue by phlox flowers and gilded here and there with flaming tiger lilies. In memory, like him, we hear again the cheerful carols of the meadow-larks, see the marsh-hawks skimming the sloughs where, now and then, a curve-billed curlew pipes its lonely call.

There he learned the manifold duties of the sturdy farm lads of his time, when not reciting his lessons in the little one-roomed red schoolhouse on the knoll. There, in his earliest days, he toddled to the humble home with a stick or two of hardwood for the kitchen stove or a basket of corncobs for kindling and, later, gathered eggs, toted water from the well, and learned how to feed the poultry, pigs, and calves. More strenuous work quickly followed. Often he longed to go fishing or gopher noosing, but had to milk and feed the cows, tend the "garden sass," and take almost a man's part with the work horses, planting, cultivating, harvesting, storing, and marketing the bumper crops of corn, oats, flax, potatoes, and upland prairie hay, and bluestem from the swales. There he knew the torture of stowing dusty timothy hay in the stifling mow of the big barn, when the mercury stood well over 100° F. in the shade. There he sat for many a long, weary day on the hard, flat board of the old wooden-wheeled Brown corn planter and dropped innumerable kernels of corn into the warm, moist, humus-rich soil, while his father drove the steady-stepping team.

Mastered All Tasks

In turn, he proudly drove the old combination Kirby mower and reaper while his dad skillfully raked off the gavels of wheat or oats, to be hand-

bound by men stationed on the four sides of the field. Perhaps he, too, had his thighs bumped black and blue by the binding table of the old Marsh harvester as he tied his half of the sheaves of sun-brittled oats? There were no self-binders, manure-spreaders, or hay-loaders in those early days. It was all hard, man-power work on the farm, and boys quickly developed into *men* to do it. The hours of toil were long, the profits small and the living frugal; but young Frank "never said die,"



Professor F. D. Gardner

stuck to his tasks, and mastered each of them.

When but 16 to 21 years old, he managed the home farm when his father was away each autumn doing custom-threshing in his district. Many a long, tedious hour he drove the sweating horses as they stumbled "round and round" running the horse-power on threshing days, and he remembers the satisfaction with which he saw, at last, the McCormick wire-binder come into use and, later, the advent of the twine-binder and other labor-saving implements.

Such was the strenuous training this hardy, handy man had for the purposeful and profitable field, crop, and soil work he was to undertake in later life. There could be no better training, and it was such as has prepared many a farm lad for eminently successful Experiment Station work, when coupled with the necessary education in science.

Being of a studious and observing nature, young Gardner determined, from his intimate knowledge of pioneer farming and its hardships, drawbacks, and small returns for the labor expended, that he would fit himself by study to help dignify and elevate the business of farming and put it on a better paying basis. As the first step toward that praiseworthy end, he became a hard-working student in the Long Course at the University of Illinois, from which institution he graduated in 1891 with the degree of Bachelor of Science in Agriculture.

Just Plain Agriculture

When he entered college, education in agriculture was unpopular and students few. He and one other were the only men, in a class of 50, who specialized in that subject. It was just plain agriculture, there being no courses in its various branches and but few books for study. The standard texts were Johnson's "How Crops Feed" and "How Crops Grow," Stover's "Agriculture" in two volumes, Barry's "Fruit Garden," Long's "Ornamental Gardening for Americans," and a few others.

How to finance his years in college was a problem, but the lad who had mastered farm work and its trials managed to make ends meet. First, he worked for his room and board by caring for a suburbanite's horses and cow, and later when the Hatch Act of 1888 allowed research experimentation on a greater scale at the University, professors gave him employment by the hour. Professor G. E. Morrow —kind, gentle, genial soul, who was at that time chief in the College of Agriculture—noted his efforts and so

approved them that young Gardner was made superintendent of the Experiment Station Farm during his junior and senior years. So well did he acquit himself as manager that after graduating he was made Assistant Agriculturist and became Professor Morrow's right-hand man. Well do we remember the excellent work done by these two enthusiasts, especially in variety tests of corn, oats, and wheat, the complete story of which is well told in some 10 bulletins of the Illinois Station.

Among his other valuable contributions to agricultural knowledge at that time were reports on the effects of different depths and frequency of cultivation on the yield of corn, of self and cross-pollenization on the character and yield of corn, and of different methods of rotation on corn, oats, wheat, and clover. He also studied with profit the effect of the time of harvesting wheat and oats on yield and weight per bushel, and the yield and composition of the corn plant in relation to its stage of maturity. He measured the daily growth of corn and made some worth while studies of the soil at various depths.

On June 6, 1894, he was married to Ellen P. Crum, and three children have graced their home.

Called to U S. D. A.

The painstaking work done by Professor Gardner at the Illinois Station attracted the attention of the officers of the U. S. Department of Agriculture, and in 1895 they engaged him to work with Milton Whitney who was then in charge of the Division of Soils. When made a member of the staff, he developed with his co-workers new methods and apparatus for soil studies, one of which, described in his first bulletin No. 6 of the Division, related to an electrical method of determining the moisture content of arable soils. He also studied and reported upon the mechanical composition of the soil as related to drainage, its water-holding capacity, capillary movements, and adaptation for crop production.

In 1899 came his first noteworthy reports on the survey work he had undertaken with Means in the Pecos Valley, New Mexico, and then with Stewart in the irrigated section of the Salt Lake Valley in Utah. These reports for many years were regarded as models for that type of work. The following year he led soil-survey parties for further soil surveys in the Sevier Valley and in Weber county, Utah. The reports with illustrations and maps may be seen in "Field Operations, Division of Soils," of the U. S. Department of Agriculture for 1900. They also were reported in Circulars of the Division, and other reports similarly published related to the manurial requirements of the Leonardtown loam soil of St. Marys county, Maryland; the Cecil silt loam of Lancaster county, South Carolina; and the Portsmouth sandy loam of the Darlington Area, South Carolina. His Circular No. 18 described the wire-basket method of determining the manurial requirements of soils.

Started Porto Rican Work

When in 1901 Congress appropriated funds for the establishment of Agricultural Experiment Stations in Porto Rico and other Insular possessions, our old friend, the late Hon. "Tama Jim" Wilson of Traer, Iowa, who was Secretary of Agriculture at that time, selected Professor Gardner as the man best fitted to undertake the work. In May of that year he sailed for Porto Rico, leaving his wife and two children behind, and soon was busily engaged in exploring the Island. After a preliminary study of its agricultural needs, he rented land and on it began some tests of crops. Early in 1902, he purchased land at Mayagueze for an experimental farm with $15,000 appropriated for the purpose by the Insular Assembly, and it is in operation there today. On it from 1901 to 1904, he conducted studies

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The Daigle Brothers of Aroostook county, Maine, know how to grow potatoes and are glad to pass on their knowledge to others.

Yield *and* Quality

By R. F. Thomas

Houlton, Maine

DOWN at Fort Kent, Aroostook county, Maine, everyone knows the Daigle Brothers—Albert and David. They are regarded as being progressive and highly successful farmers. If you would ask why these men are considered more successful than the average farmer, you most likely would be told that it is because they are always striving to find some new method that will make their business more profitable.

The Daigle Brothers believe that if one is to be truly successful, it is necessary to do a better job than one's competitor. Consequently, early in their farming career, they set their minds to growing better seed potatoes. In this field they have made an enviable reputation for themselves. Their interests have centered on such fundamental factors as tube-unit seed plots to get the best possible seed, spraying for control of disease, and the relation of fertilization to yield and quality. All of these were necessary in their major enterprise, the production of *Quality Green Mountain Seed.*

Soil fertility, the Daigles have found to be an important factor in their operations. Not satisfied with their yields and wishing to determine what if any influence fertilization might have on quality, they undertook an experiment in 1929 to see what they could learn. The experiment was conducted on second crop, or on land that was in potatoes the year before. Certified Green Mountain seed were used.

In the fertilizer experiment, the basic application was 2,000 pounds per acre of 5-8-7 fertilizer. This was compared with analyses containing the same percentage of nitrogen and phosphoric acid, the potash being varied from 7 per cent up to 20 per cent, in several steps.

Throughout the growing season they observed a marked difference in the habit of growth of the potato tops. Those on the high-potash plots stood up more erect, were more stocky, and died down more slowly in the fall. Results at harvest showed that the 7 per cent plot produced a total yield of 150 barrels per acre, while the 10 per cent plot yielded 186 barrels, or 36 barrels more than the 7 per cent plot. While slightly larger yields were obtained from the plots receiving 11 and 12 per cent potash, the most economical returns were from the plots receiving 10 per cent potash.

10% Potash Improved Quality

The potatoes from each of the plots were graded by hand in order to study type, condition, and other characteristics to meet requirements for certification. It was found that the 10 per cent potash plots produced 15 per cent more U. S. No. 1's than the plots having only 7 per cent potash in the fertilizer. An examination of the potatoes from the 10 per cent potash plots showed that the type was superior. They were blockier, smoother lined, better developed, free from secondary growth and growth crack; the eyes were shallower; and the "cheek-bones" surrounding the eyes were lower and smoother.

The Daigle Brothers say that there was a marked difference in the cubical contents of a 165-pound bag of potatoes from the 7 per cent and 10 per cent potash plots. "It was difficult in many cases to get 165 pounds of the 7 per cent potash potatoes into the bag, while in every case with the 10 per cent potash potatoes there were about three inches of space left, making sewing of the bags easier." The reason for this they suggest is that "the potatoes grown on the 10 per cent potash fertilizer were more even in size, blockier, and better developed." They observed also that the 7 per cent potash potatoes were more brittle and watery, skinned more easily, and if dropped on the floor they invariably cracked open. Cooking tests made in the homes of the Daigle Brothers further revealed the fact that the 10 per cent potash potatoes were whiter, mealier, and more palatable than those receiving the 7 per cent potash.

So convincing were the results of the test in 1929 in favor of the 10 per cent potash fertilizer that Daigle Brothers fertilized their entire crop with this analysis in 1930. They wisely decided, however, to repeat the test with 7 and 10 per cent potash on a clover sod, in order to check against second crop. They observed the same general plant characteristics as during the previous year. Harvest records showed that the 7 per cent potash yielded only 164 barrels per acre, while the 10 per cent potash yielded 191 barrels, or 27 barrels in favor of the 10 per cent potash fertilizer. Again it was noticed that the higher potash fertilizer produced a tuber of superior type.

"We Are Through Experimenting"

Commenting on the results of these tests, the Daigle Brothers said, "10 per cent potash produced equally as good results with us on both second crop and sod in two different years. We are all through experimenting with it because we are convinced that 10 per cent potash will give us larger yields of better quality potatoes."

Fortunate is the man who can spend a day or two visiting and talking with the Daigle brothers. Not only will he learn of their experiences with fertilizers and crop rotations that insure high yields and quality, but if the visit is made during the growing sea-

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New Light on

POTASH-HUNGRY CROPS

By A. B. Bryan

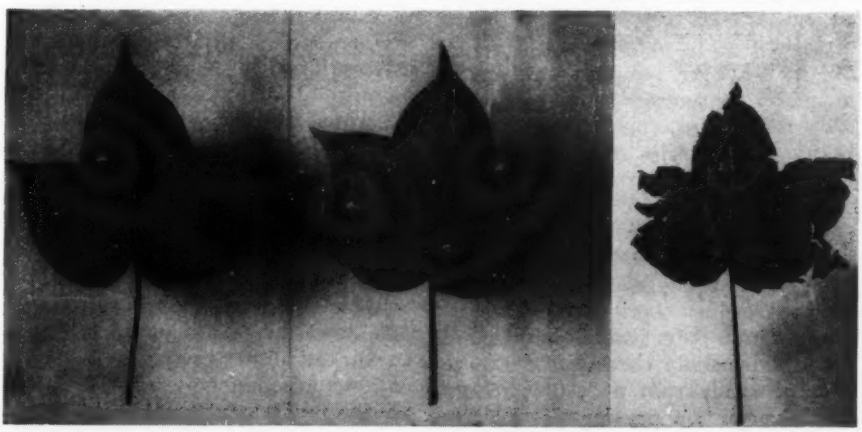
Clemson Agricultural College, Clemson College, South Carolina

COTTON plants that are hungry for potash show their hunger first by turning pale and then in desperation by getting red in the face, so to speak. In other words, potash deficiency manifests itself in a rusty appearance and unhealthy condition, the net result of which is premature shedding of leaves, imperfect boll development, inferior quality of lint, and lower total yield. Hence, there is value in any new light shed on this old trouble which cotton farmers have for some decades called "rust" but have generally known very little about.

This particular ill health in the cotton plant is, the agronomists and plant physiologists say, a physiological trouble due to a deficiency of available potassium. It is, to speak briefly and plainly, "potash hunger" and can be cured, like any other kind of hunger, by feeding the starving body with that for which it hungers.

Long before farmers knew anything scientific about potash hunger, observant ones among them noticed that rust occurred most often in sandy types of soil under certain weather conditions, and the progressive farmers found more or less by chance that there was less rust when the fertilizer formula contained potash.

The first deficiency symptoms of



Potash-hunger signs in cotton: Left, normal leaf; Center, margins affected; Right, advanced stage, entire leaf affected.

potash hunger in cotton usually occur from late July to early August. The symptoms first appear as a yellowish-white mottling of the leaf. The leaf changes to a light yellowish-green color and yellow spots appear between the veins of the leaf. The centers of these spots die and numerous brown specks occur at the tip, around the margin, and between the veins of the leaf. The tip and the margin of the leaf break down first, resulting in a curling downward of the tip and the margin of the leaf. As the physiological breakdown progresses, the whole leaf finally becomes reddish-brown in color, dries, and is shed prematurely. The premature shedding of leaves prevents the proper development of bolls, and therefore many fail to open. The cotton is hard to pick, and the lint is often of inferior quality.

The characteristic abnormalities in the advanced stage of potash hunger in cotton may be summarized briefly as follows: tips and margins of leaves die first; the tips and margins of the leaves are curved downward; the margins of the leaves are often torn and ragged; the normal green color of leaves disappears, especially along the margins; the leaves become reddish-brown in color, dry, and are shed prematurely; many of the immature bolls fail to develop; many of the bolls fail to open; lint is of inferior quality.

Legumes Also Suffer

Potash-hunger symptoms are common also in summer annual legumes such as soybeans, cowpeas, and velvet beans. The margins of the leaves become yellowish-white and finally break down.

Many cotton fields in Dixie showed potash hunger in 1932, and therefore some tests being conducted by the South Carolina Agricultural Experiment Station at its Sandhill branch and among farmers in the heart of a large area of sandy soils of the Carolinas and Georgia are proving particularly interesting and important. The results are significant wherever cotton is grown and especially where soils are sandy.

Data are becoming available on what happens when additional potash is added to cotton fertilizer formulas, on the effect of different rates of application of potash, and on the effect of applying the potash at different times during the growing season. Cotton in some of the experiments gave remarkable increases in yields where relatively large amounts of potash were contrasted with no potash. Further, the yield of cotton increased with the increase in the rate of potash fertilizers added. There seemed to be also some relation between yield of cotton and time of applying potash fertilizers, all at planting giving lower yields than all at chopping or half at planting and half at chopping.

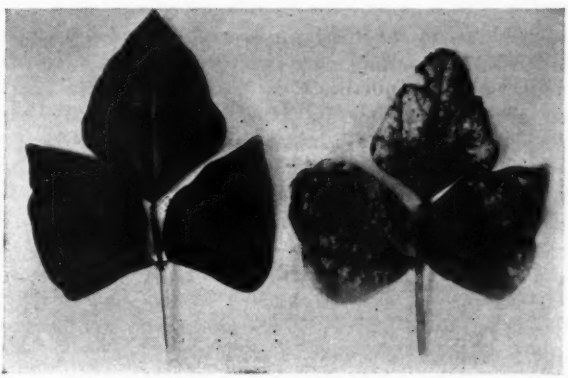
Increases Due to Potash

In one potash test there was a difference of 1,138 pounds of seed cotton per acre between the plot which received no potash and the plot which received 100 pounds of sulphate of potash plus 138 pounds of magnesium sulphate per acre. There was an increase of 1,108 pounds of seed cotton per acre on the plot that received 240 pounds of high-grade kainit (20%) over the plot that received no potash.

In a test on rate of potash application for cotton with calcium nitrate versus sodium nitrate there was an increase in yield of seed cotton from sodium nitrate over calcium nitrate. This increase in yield was in indirect ratio with the rate of potash applied. On the no-potash plot there was an increase in yield of 160 pounds of seed cotton per acre from sodium nitrate over calcium nitrate. The increase was only 21 pounds of seed cotton per acre on the plots which received 120 pounds of muriate of potash per acre. In this test all plots received 45 pounds of ammonia and 60 pounds of phosphorus per acre.

A combined rate and time test of applying potash to cotton is worth

careful study. The rates of application were 15 pounds of K_2O and additional increments of 15 pounds up to 60 pounds. The times of application were: all at planting; half at planting and half at chopping; and all at chopping. All plots were fertilized at planting with 600 pounds per acre of a 5-10-0 (NPK) and side-dressed with 83.3 pounds of calcium nitrate at chopping. Increases in yield due to split applications over all at planting were not great—5 pounds of seed cotton for 15 pounds of K_2O and 66, 26, and 34 pounds for 30, 45, and 60 pounds of K_2O, respectively. Increases due to applying all at chopping were 33, 29, 12, and 14 pounds of seed cotton for the four rates of K_2O, respectively.



Potash-hunger signs in cowpea: Left, normal leaf; Right, potash hunger, yellowish-white color around the margin and puckering of the leaf.

The increases in yields from increased amounts of potash, however, were important. From an average of 1,225 pounds of seed cotton per acre on the three plots receiving 15 pounds of potash there was an increase to 1,343 pounds for the 30 pounds of potash, to 1,404 pounds for the 45 pounds, and to 1,508 pounds for the 60 pounds.

These data suggest that for the rates used, under conditions prevailing on many farms, one might expect a pound of muriate of potash to produce between three and four pounds of seed cotton.

Efforts of Southern research workers to improve the yield and quality of bright flue-cured tobacco in recent years have shown the importance of better use of fertilizers as well as varieties, methods of cultivation, rotation, spacing, and curing.

At the Pee Dee branch of the South Carolina Experiment Station tests to determine the amount of potash needed to produce the best quality of tobacco are showing that a liberal supply of potash in the fertilizer mixture seems to have several desirable effects on quality: maintaining vigor in the plant; giving resistance to leaf-spot diseases; and making, as a rule, the desirable smooth leaf. From these studies and those made in North Carolina, Virginia, and Georgia come specific recommendations and suggestions:

For heavy or more productive soils a mixture containing 8 per cent available phosphoric acid, 3 per cent ammonia, and 5 per cent potash; for light or less productive soils 8, 4, and 6 per cent respectively. For the better types of soils, where high topping is practiced, 8 to 10% potash in the fertilizer is recommended. These analyses are best applied, 800 to 1,200 pounds per acre, in the drill and well mixed with the soil within 10 days of setting plants.

The potash may be derived from any available source provided the chlorine content of the mixture is not over two per cent, since excessive chlorine injures growth and quality. Any tobacco by-products used as a source of potash must be sterilized to guard against disease.

A comprehensive series of fertilizer

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The Best Fertilizers *for* Potatoes

By T. E. Odland

Agronomist, Rhode Island Agricultural Experiment Station

POTATOES have been used as a standard crop in many fertilizer, crop-rotation, and other experiments at the Rhode Island Station over a long period of years. These experiments have produced considerable data on the fertilizer response of this crop in addition to the information for which each of the different experiments was especially planned. Some of the results which will be mentioned here have been published in different bulletins and papers dealing with the particular experiments while other results have not been previously published.

A number of experiment stations have done considerable work on the fertilizer requirements of potatoes. The recommendations have differed considerably depending upon the soil type, geographical location, and variety of potatoes being grown. In the South generally a higher percentage of nitrogen is recommended than in the more northern States. In the northeastern States fertilizer fairly high in potash generally has been found most effective. The response to phosphorus has varied somewhat. In a few experiments increases in the amount of phosphorus in the fertilizer have given greater increases in yield than increases in either nitrogen or potash. In the New England States the response to potash has been the most significant.

Potatoes are included as one of the crops in various rotation experiments at the Rhode Island Station. The fertilizers used have been similar although not always alike for all rotations. Manure is used once in four years for the corn crop in rotation D and on half the plats for corn on rotation B. The rotations vary in length from three to six years. Between 1,500 and 2,000 pounds per acre of a fertilizer ap-

TABLE I. YIELD OF POTATOES IN DIFFERENT ROTATIONS

		Bushels per acre				
Year	Rotations—B	C	D	E	F
1894-1929	(average)	278	279	285	265	284
1930		374	400	468	340	409
1931		251	292	247	230	274
1932		298	289	253	284	392

Rotation B—Potatoes, hay 4 years, corn
" C— " rye, hay
" D— " " " corn
" E— " " hay 2 years, corn, (legume)
" F— " " " corn, (non-legume)

Left—Medium Nitrogen; Right—High Nitrogen. Rhode Island Agricultural Experiment Station, 1929.

proximating a 4-8-8 have been used much of the time. Lime is applied once in each round of the rotation. The results obtained are summarized in table I.

Beginning with 1930 the rye crop has been replaced by another year of hay in these rotations. Early potatoes are grown, and the grass seed is planted immediately after the potatoes have been dug.

As may be seen from the figures in table I there has not been much difference in average yields of potatoes on rotations B, C, and D over the 39-year period that these comparisons have been under way. Rotation E has produced the lowest average yield, and rotation F has been among the highest. Both E and F are 5-year rotations, receiving the same amount of fertilizer over the 5-year period and receiving no manure. The difference between the two is that rotation E has legumes included in the hay mixture, while in rotation F only grasses are seeded.

Although the same amount of nitrogen is applied over the 5-year period to these two rotations, the amount for the different crops is not the same. More nitrogen is applied for the hay in rotation F than in rotation E and consequently less is applied to the other crops in the rotation. As a result the nitrogen applied for the potato crop averages about 20 per cent less on rotation F than on rotation E.

These results show that with proper fertilization potatoes can be grown very successfully in a regular rotation without the use of stable manure. The results obtained in rotation E and F indicate further that in rotations where legumes are included the nitrogen content of the fertilizer should not be too high. Further evidence on this latter point will be presented.

In connection with these rotation plats there are certain others which are known as fertilizer checks. To these plats are applied various amounts of nitrogen, phosphorus, and potash. A 5-year rotation like that used for rotation E is followed on these check plats. No manure is applied and lime is applied once in each round of the

Left—High Potash; Right—Low Potash. Rhode Island Agricultural Experiment Station, 1929.

rotation.

The results with different nitrogen levels are shown in table II.

TABLE II. YIELD OF POTATOES ON NITROGEN EXPERIMENT

Year	No nitrogen	Medium nitrogen	High nitrogen
1909	203	232	289
1914	387	438	456
1919	245	338	325
1924	263	323	335
1929	252	333	235
Average	270	333	328

Even without any nitrogen in the fertilizer, fair yields have been obtained in this rotation. On the medium nitrogen plat about 1,500 pounds of a 3-9-8 have been used, and on the high nitrogen plat the same amount of a 6-9-8. Evidently the 6 per cent of nitrogen was more than this crop needed under these conditions. This would help to explain also why rotation F has surpassed rotation E in average yield over the 38-year period.

Turning now to the story on phosphoric acid and potash we find similar check plats have been used for these ingredients. In table III the results are shown.

The chief difference in these results has been the increased yields where the high potash has been used. On the low potash the fertilizer has been 1,500 pounds of a 4-9-5 and on the high potash the same amount of a 4-9-10. On the high and low phosphorus plats the ratio has been 4-6-8 and 4-12-8. Little difference in yield has resulted from this difference in the amount of phosphorus used.

In the year 1929 the potatoes on the low potash plat were almost 100 per cent scabby, while very clean ones were produced on the high potash.

The amount of fertilizer to apply is also an important question. In certain check plats different amounts of the same fertilizer are used on the various crops grown in the rotation. The results with potatoes are shown in the following table.

TABLE III-a. POTATOES WITH DIFFERENT AMOUNTS OF FERTILIZER

	1,000 lbs.	1,500 lbs.	2,000 lbs.
1911	163	233	244
1917	322	357	374
1924	241	282	335
1929	207	311	316
Average	233	296	317

There was profit in increasing the fertilizer from 1,000 to 1,500 pounds per acre for potatoes but not in increasing it to a ton per acre.

From these experiments we have come to the conclusion that a high-potash fertilizer for potatoes is very desirable under such systems of crop rotation as here followed on this soil type. The phosphorus response is not as noticeable and the amount of nitrogen applied may easily become more than is necessary. Some growers probably use more fertilizer for the potato crop than is economical.

In connection with these experiments tests have been made on different methods of applying the fertilizer. Other stations have made similar tests with corn, cotton, and other crops. Not so much has been done in the way of fertilizer placement tests for potatoes.

TABLE III. YIELDS OF POTATOES ON POTASH AND PHOSPHORUS EXPERIMENT

Year	High potash	Low potash	High phosphorus	Low phosphorus
1914	464	440	465	475
1919	333	322	296	318
1924	316	276	337	306
1929	336	204	304	297
Average	362	310	350	339

TABLE IV. YIELDS OF POTATOES WITH DIFFERENT METHODS OF FERTILIZER APPLICATION

Year	Broadcast	Cultivated in furrow	Method of Broadcast: Below seed	Above seed	Side of seed
1926-27	295	388	405	363	
1928-29		305	317	305	300
1930-31	238		339	325	314
1926-31			347	327	

Five methods of placing the fertilizer have been used in the Rhode Island tests. The results are shown in table IV.

As may be seen from these figures, the poorest yields were obtained where the fertilizer was broadcast. Differences so great were not obtained with the other methods. If there is any advantage, it is where the fertilizer was placed below the seed.

These results with potatoes agree with those obtained at other stations with other crops; namely, that the nearer the fertilizer can be placed to the seed without causing injury to it, the better the results generally obtained.

In most potato planters now in common use the fertilizer is placed near the sides of the seed piece. If a good uniform distribution is obtained and the fertilizer is placed well down, this is probably as efficient a method as we know about at the present time.

A question that is often asked in regard to a fertilizer is what is the relative value of the different materials that may be used for making up the fertilizer.

In the rotation experiments that I have mentioned, the nitrogen is obtained in equal amounts from nitrate of soda and sulfate of ammonia. The phosphorus is from superphosphate, and the potash from sulfate of potash.

In one of the experiments under way at Rhode Island there is a test of different potash carriers. Potatoes have been used regularly as one of the cultivated crops in these tests. The different sources include kainit, muriate, sulfate, and sulfate of potash-magnesia. The yields obtained are shown in table V.

These figures show that on the average there has not been much difference in results obtained when like amounts of potash have been applied in the different materials. In actual bushels the sulfate has yielded just a little above muriate and the double manure salt a little less. Part of the reduced yield with the double manure salt is due to a lesser application of this for several years due to an error in calculating the amount to use from the analysis. Where the amount of potash was doubled the yield was increased by 50 per cent.

Left—Without Magnesium. Right—With Magnesium. Rhode Island Agricultural Experiment Station, 1932.

For several years a cooking quality test of the potatoes was made in connection with this experiment. It was found that the high potash plat produced the more mealy potato. The very low potash produced a potato that was soggy when cooked. What little difference there was between the quality produced by the muriate and sulfate seemed to be in favor of the muriate of potash.

A similar test with different sources of phosphorus has also been conducted for a number of years. The materials included have been superphosphate, slag, bone-meal, rock phosphate, and triple superphosphate. These have been used both with and without lime. The average yields have been about equal with superphosphate, slag, and triple superphosphate. The bone-meal and rock phosphate have not done as well. With no or very low phosphorus the yield has been still less, but not as markedly so as where potash has been reduced or left out.

On most of the plats a liming program has been followed, so that no magnesium deficiency has been noted with potatoes. On a few plats where little lime has been applied, the potato crop shows what has been recognized as magnesium deficiency. This is especially true where extra nitrogen or potash is supplied in the fertilizer and in this way an early vigorous growth is induced. On the non-limed plat in 1931 and 1932 where potash was used at the rate of 225 pounds of K_2O per acre, the yield was reduced by about one-third over the plat where 150 pounds of K_2O were used. Similar results were obtained on the non-limed plats where nitrogen was increased.

During the past season several cooperative experiments were conducted with potato growers in the State. In one test no benefit was obtained from adding magnesium to the fertilizer; on another farm the magnesium increased the yield by nearly 100 bushels per acre. The other tests ranged between these two. Magnesium was added in different forms and all were effective. Adding a small amount of dolomitic limestone to the fertilizer or applying it as a light top-dressing is an effective way of supplying magnesium.

These different fertilizer and lime tests indicate that it is worth while to give some thought and study to the problems of selecting the best fertilizer for our potato crop as well as for other crops that we are raising. We may be able to save by applying less in certain cases and make more profit by increasing certain of the ingredients in other cases.

TABLE V. YIELDS OF POTATOES WITH DIFFERENT POTASH SOURCES

	Potash Sources					
	Kainit	Muriate	Low Potash	Sulfate	Potash-Magnesia	Extra Sulfate
Plat No.—	114	115	116	117	118	119
Year						
1920	137	163	56	125	127	271
1922	166	124	47	106	134	179
1923	174	158	67	180	128	288
1926	170	194	72	202	193	348
1927	194	167	81	187	144	335
1930	323	383	236	393	302	461
1931	339	323	195	365	336	403
Average	215	216	108	223	195	326

Application 1930-31, 1 ton 4-8-5, 4-8-2, and 4-8-10.

He Knows the Reason Now and Has——

Quit Wondering

By G. Chalmers McDermid

Charleston, South Carolina

"I'M sorry, Mr. Mac, but I won't be able to accept the extra 20% kainit which you promised to give me again this year for my asparagus test. I just can't take it because you will insist that I run an acre of my 'grass' as a check plot. I find, after my two years of experimentation with 800 pounds of 20% kainit in addition to my regular fertilizer, that I just can't afford to do without it and lose the extra money on that check acre. I have quit wondering about extra potash making better asparagus. I know about it now, and in the future I will use it on my whole field, instead of on just an acre or so."

Mr. Lang Cave, Barnwell, South Carolina, asparagus grower, and a hill of Colossal "grass."

The above conversation took place when the writer met Horace Rentz, Bamberg, South Carolina asparagus grower, after Mr. Rentz's second season of demonstration work with extra potash on his young asparagus field. Final results of these two years' work, in which Mr. Rentz kept an accurate cutting record, showed a difference of 37 bunches per acre in 1931 and 69 bunches in 1932. In both of these cutting seasons, the previous summers were extremely dry, and plants did not attain normal top growth. Naturally, the cutting of the following spring was curtailed. However, the difference in yield on "grass" which was in its third and fourth year of cutting was well worth while, and not only Mr. Rentz but several of his neighbors became convinced of the need of larger amounts of potash for their "grass" crops than they had been using in the past.

Another record of interest to "grass" growers, part of which has already appeared in these columns, is that of Lang Cave of Barnwell, South Carolina, using 500 pounds of muriate of potash as his source of additional potash. Mr. Cave started his demonstration in 1929, applying 500 pounds of muriate per acre. His regular fer-

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This corn on the farm of O. C. Hammond, New Market, Alabama, was fertilized with 100 lbs. muriate of potash and 100 lbs. 16% superphosphate per acre. The average yield per acre on slightly more than nine acres was 62.03 bushels.

Six Bushels *for* One

By W. H. Appleton

Gadsden, Alabama

A TOTAL increase of approximately 475 bushels of corn was obtained by O. C. Hammond, New Market, Alabama, on slightly more than nine acres from a per-acre application of 100 pounds of muriate of potash and 100 pounds of superphosphate. Prior to 1932 about 75 bushels was the average total yield on this area, or an average per-acre yield of about eight bushels. The per-acre yield the past season, when the above fertilizer treatment was used, was 62.03 bushels per acre.

Ten bushels, which was the approximate yield obtained in the better years on this area in the past, was used as a basis of comparison with the 1932 yield in arriving at the total increase mentioned above. Even on this basis, the increase due to this fertilizer was more than six times the yield that Mr. Hammond could have expected had he used no fertilizer on this corn in 1932. He commented, "I have produced in one year what it would have taken 5 to 7 years to produce if I hadn't found that this fertilizer mixture was what my corn needed."

The total fertilizer cost for the area was about $30. Though figuring corn at 25 cents per bushel, it is found that Mr. Hammond got about $4 worth of corn for each $1 spent for fertilizer.

It was on July 1, 1931, that Mr.

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Better *Quality* in Sauerkraut

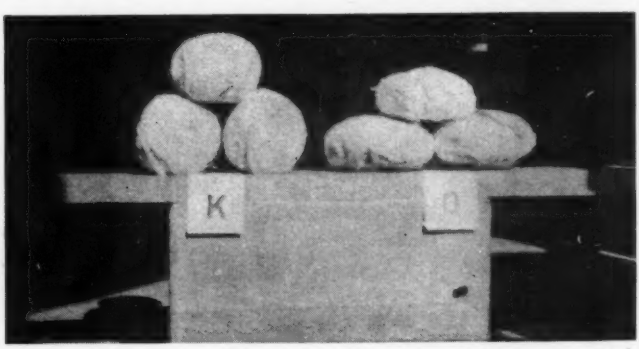
By C. H. Wadleigh

Ohio State University, Columbus, Ohio

HE who knows the delectable tang of a well-prepared dish of spareribs and sauerkraut does not have to be convinced of health-giving properties to partake of this dish. She who includes this food in her diet because of its mineral and vitamin content soon learns to appreciate its savoriness. But all kraut is not alike. The connoisseur recognizes that there is considerable variation in the quality of sauerkraut. But if he asks "Why?" the answer is elusive.

Both the commercial and the home manufacturer all too often experience disappointment with the quality of their product. In many instances this is due to faulty preparation, resulting in the growth of undesirable rather than desirable yeasts and bacteria. Elaborate studies conducted at the University of Wisconsin have shown that either too high or too low temperature of the sauerkraut during fermentation is detrimental to its quality. A temperature of 65 to 70 degrees Fahrenheit appears to be about the optimum. It has also been shown at that institution that washing the cabbage helps to produce a better quality of kraut. The amount of salt used (2½ per cent appears to be the optimum) has its influence on the final product. All these factors affect mainly the bacterial activity occurring in the sauerkraut during fermentation.

What is quality in kraut? Good sauerkraut is of light straw-yellow color, crisp but neither tough nor soft in texture, with a characteristic acid flavor resulting from typical lactic fermentation. The acidity content should be at least 1½ per cent calculated as lactic acid when fermentation is complete. The trade also places stipulations on the size and length of the cut. Manufacturing operations easily control the dimensions of the cut, but many experienced kraut packers have followed every precaution



Both groups of cabbage were of the same variety (Globe Glory) from the same source of seed and were grown in the same field in adjacent plots. The heads at the left (K) received 1,000 lbs. of 4-10-12 per acre, and those at the right (O) received 1,000 lbs. of 4-10-0 per acre. The heads shown were typical for the respective plots.

known to them with respect to the preparation of their product and still do not secure satisfactory results.

Usually, too little attention is paid to the type of cabbage used in the making of sauerkraut. A good kraut cabbage should be mature, solid, and free from greenness in the leaves of the head, and yet it should not be "over-ripe," tough, and woody.

In a study conducted at The Ohio State University, sauerkraut was made from cabbage that had been severely stunted during its growth. The cabbage had been set in the field in April in anticipation that it would be harvested in July. Due to lack of fertilizer and water, this cabbage did not mature until the latter part of August. During the growing period, the plants were very stunted in appearance, light yellowish green in color, and the lower leaves were yellowing, drying up, and dropping off—symptoms quite typical of nitrogen starvation. The heads were small, very hard, and woody in texture. The kraut that was made from this cabbage had a satisfactory acid flavor and a very desirable light color, but its texture was very tough and leathery.

Made Other Tests

In another test, cabbage which had been grown on a muck soil with an abundance of water and nitrogenous fertilizer was selected for kraut making. This cabbage had large, dark green exterior leaves with about a three-foot spread. The heads were large, succulent, and not very firm. The sauerkraut made from it had a characteristic acid flavor, but was a bit too dark in color, and was too soft in texture.

Sauerkraut was made from cabbage to which 1,000 pounds of a 4-0-6 fertilizer had been applied per acre. The plants presented a stunted appearance; the exterior leaves were covered with a heavier coat of "bloom" and tended to grow up vertically rather than to spread horizontally; the lower leaves were becoming yellow or purplish-yellow, drying up, and dropping off somewhat similar to plants starving for nitrogen. However, the soil gave a very high test for nitrogen. The cabbage was small, but solid and well blanched. The kraut was of very good quality, crisp, light-colored, and of good flavor.

Potash-starved cabbage, grown on a highly organic sandy soil which had received 1,000 pounds of 4-10-0 per acre, was made into kraut. These plants presented a normal, dark green color; but after they had been in the field about five weeks, "firing," or dead areas, began to occur on the margins of the lower leaves. This condition rapidly increased in severity until the majority of the exterior leaves had died and dropped off. The heads were small, with a decided tendency to flatten out, rather soft and succulent, and not very well blanched. The kraut was soft, somewhat dark in color, and had a slightly bitter tang. Kraut was also made from cabbage which was grown on the same soil in this same field, but which had received 1,000 pounds of a 4-10-12 fertilizer. Not only was the yield doubled over the potash-deficient plot, but the cabbage presented a normal appearance and made very good kraut in all respects.

Depends on Sugar Content

It has been observed that sauerkraut, made from cabbage which has been supplied with an excess of nitrogen, will not develop sufficient acidity. Analyses of cabbage of this type indicated that its total sugar content was only 2.5 per cent. Since it is necessary for cabbage to have a sugar content of at least 3 per cent in order to permit the development of 1½ per cent lactic acid in the sauerkraut, there is at once apparent one reason why this particular cabbage did not make good kraut.

Most of the studies that have been made indicate little correlation between the chemical analysis of the cab-

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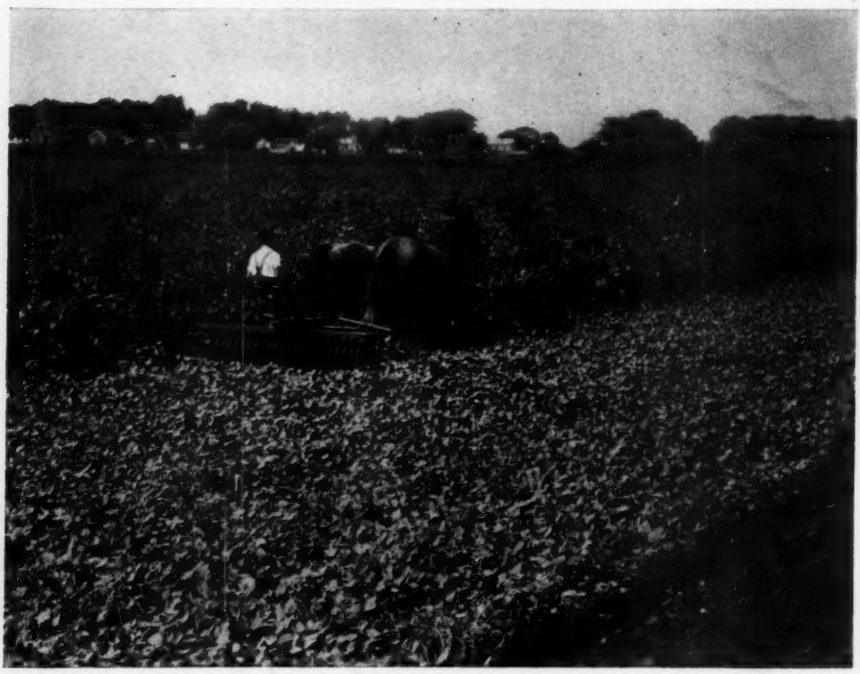
Pictorial

HOLD EVERYTHING!

Above: The interior of the cantaloup-packing shed on the D. F. Stahlman Ranch, La Mesa, New Mexico.

Below: Rolling down a heavy crop of soybeans so that they may be more easily plowed under, on the farm of Leonard Hill, Douglas, Illinois.

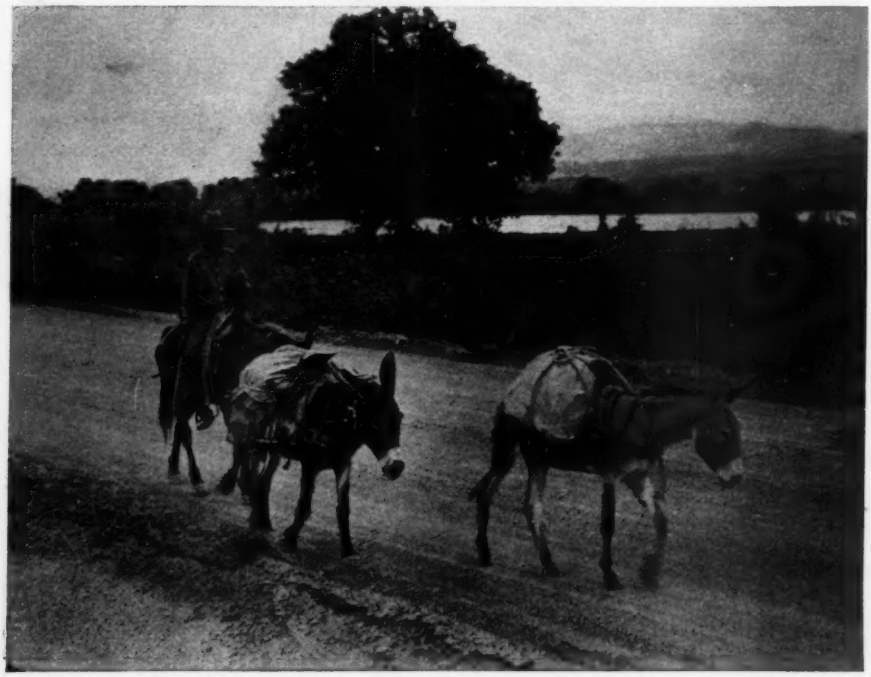


Above: Drying peaches in the sun, near Yettem, California. Sulfur is burned under the cut fruit in the sheds, then it is placed in the sun for two days.

Below: These are not woolly worms, but a fine field of White Wonder millet, near Enid Oklahoma.

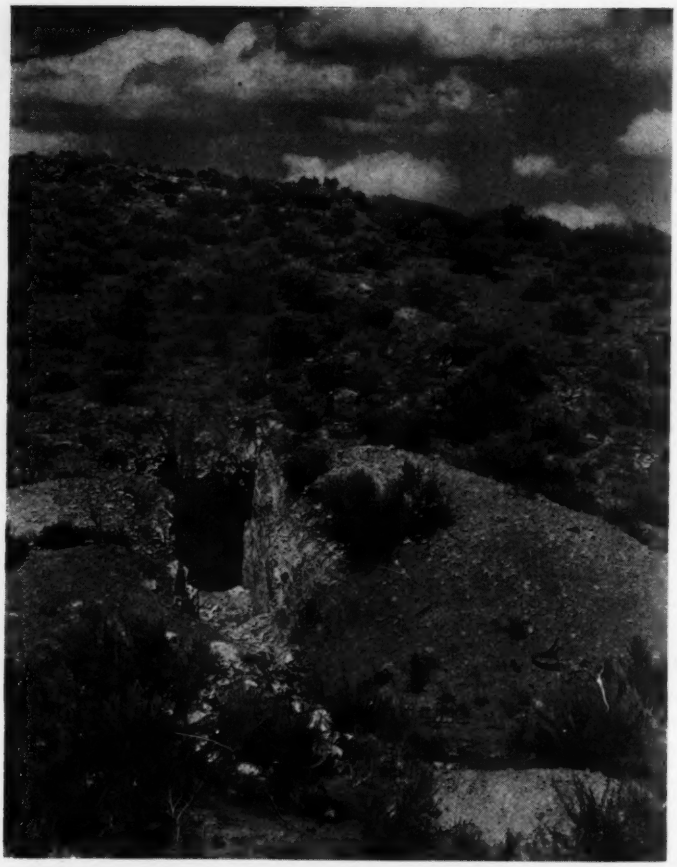
Above: A well-planned garden, protected by a picket fence, provides the cozy cabin home of J. W. Kennedy in the Ozarks near St. Joe, Arkansas, with plenty of fresh vegetables.

Below: In search of prosperity—Bob Howard, prospector of Arizona and New Mexico, with his pack burros on U. S. Highway 85 along the Rio Grande river.



Above: Farming—a gamble with the elements. This is not a snow scene, but a field of corn near Bridgeport, Nebraska, which has been riddled by hail.

Below: On the plantation of Arthur Alexander, Little Rock, Arkansas, this neat, white-washed shanty showing across a field of cotton suggests song titles.



Left: An entrance to a mine in the side of a mountain near Contact, Nevada.

Below: Jackson lake and the Teton mountains in Teton National Park, Wyoming.

The Editors Talk

Our Changing Agriculture

In common with all human endeavor, the agriculture of North America is passing through a period of change, probably the most vital that has occurred in a century. While revolutionary changes have occurred in the past, they have often been on the order of single changes, as the development of farm machinery, against a more or less stable background. The difference now is that violent agricultural changes are occurring against a national and world background that is itself subject to violent and rapid change. Not only are the figures on the stage, but the stage itself, moving. There is thus a need now greater than ever before for a restrained and sympathetic interpretation of all that happens day-by-day.

What present changes will eventually mean in terms of agricultural life and practice or in its larger aspects, its relation to our national life, it is at present hard to say, for we are too close to the picture. Viewing the picture in broad outline, however, major activity seems to be changing from a world governed primarily by social motives and objectives, such as a better working expression for democracy, greater liberty for the individual man, more peace and less war, temperance movements and other social motives, to a world in which economic motives and objectives are assuming a much larger place and pressure. In this changing world motivation we are bewildered and at a loss to know how to proceed. But certain it is that whatever the outcome, the good of the nation demands a solvent and profitable agriculture. This is the business and interest of everybody. A thriving agriculture must be sought, not by farmers and government alone, but by people as a whole. For instance, to take a question in point, can urban communities expect their trade to be protected by government measures at a relatively high price level and rural communities be expected to accept a relatively lower world price for say, cotton, wheat, and hogs? This one question alone affects both the rural and urban citizen. It implies the necessity for mutual understanding by urban and rural citizens. There are many other mutual questions, as problems of the gold standard, mortgage debts, etc., etc.

The press as a whole has done excellent work in bringing such problems to the attention of all our people, but there is a vast amount of work yet to be done in the field of honest, simple, and systematic interpretation of agricultural problems as they relate to rural life on the basis of the facts as they are understood by the best-informed minds of today.

Rural communities and organizations, on their part, are under an obligation to help in furthering this sympathetic understanding by a presentation of their problems with restraint and a basic sympathy and understanding, as far as possible, of national and world difficulties. Many organizations and farmers are leading in this spirit. Large numbers of farmers, possibly more than people think, have adjusted themselves to a changing economic world by more efficient organization and management of their individual farms; but all too many have accomplished this by a reduction of their standard of living, much below what it should be.

It is to be hoped that as a basis for the solution of pressing agricultural solvency, this large and stable part of our agricultural life can find some accord with equally sympathetic and stable elements in urban life. Such an interpretative understanding is creative work of the highest order. Any part of the press that helps in this work is undertaking a task that, if well done, may yet be one of the most necessary and lasting contributions to the well-being of our national life.

Pastures in Quebec

Competitions in connection with the fertilizing of pastures have been announced by the Quebec Department of Agriculture, as reported by the Canadian Pacific Railway magazine entitled "Agricultural & Industrial Progress in Canada." The possibilities of improving pastures have already been demonstrated by experiments carried out by the Department of Agriculture and Macdonald College. It has been shown that the results more than justify the time and money spent. The use of commercial fertilizers have increased not only the yield, but the quality of the pasture.

The competition is to be conducted under the auspices of the Rural Economics Branch of the Quebec Department of Agriculture. Four dollars an acre will be paid as a bonus up to a maximum of 100 acres; the requirements being that the fertilized area of the pasture must adjoin the non-fertilized area. It is felt that this competition will bring home to hundreds of farmers the importance and possibilities of improving pastures.

Potash-Hungry Crops

Due to the smaller application of fertilizers that are commonly used, potash hunger on cotton has been amply demonstrated during the past season. An interesting and instructive article on this subject by A. B. Bryan will be found in another part of the magazine.

As stated by the author, "cotton plants that are hungry for potash show their hunger first by turning pale and then in desperation by getting red in the face, so to speak. In other words, potash deficiency manifests itself in a rusty appearance and unhealthy condition, the net result of which is premature shedding of leaves, imperfect boll development, inferior quality of lint, and lower total yield."

This appearance of cotton rust is well known. Long before scientists had found out anything about the nutrition of cotton, observant farmers had noticed that rust occurred on sandy types of soils under certain weather conditions. The article discusses data on what happens when additional potash is added to cotton fertilizer formulas, on the effect of different rates of application of potash, and on the effect of applying the potash at different times during the growing season.

As with low prices the economy of crop production becomes a more and more urgent matter, any work that has for its purpose the elimination of evidences of malnutrition is both practical and necessary. It is quite evident that if cotton rust is to be controlled, then in conjunction with other fertilizers the right amount of potash must be used at the right time.

Agricultural Outlook Report

Improved demand for farm products waits on the recovery of heavy industries where a large part of the unemployment exists, according to the annual "Farm Outlook Report" issued recently by the Bureau of Agricultural Economics, U. S. Department of Agriculture, after a long conference with extension farm economists representing 32 States.

The Bureau also sees some possibility of improvement in the economic situation during the 1933-34 season and in the demand for farm products, especially if there should be an easing of the strangulating effects on our foreign trade arising out of unstable currencies, international debts, and trade barriers. It is stated, however, that there is little prospect at present for an early improvement in the foreign demand for our agricultural products." Conversely, effective international action this year directed towards correcting the factors that are suppressing foreign trade would be a strong impetus towards economic recovery throughout the world.

Therefore, it is to be sincerely hoped that out of the international conferences to take place this year some kind of action will be evolved that will permit one nation to trade with another in greater volume than has been the case during recent years. To effect this end, however, means that large groups of people in each country must be responsive to the need for international trade. It is certain that the sale of farm products abroad in larger volume, at even slightly better than present prices, will go a long way towards helping the farmer out of his financial difficulties. Thus it would seem that farm organizations have something to gain by studying the problem from the point of view of world trade and markets.

Peat Soils at Home and Abroad

Increasing attention is being given to peat soils, both at home and abroad; all the way from sunny Florida to the storm-swept Island of Lewis, off the western coast of Scotland in the outer Hebrides. For on the Island of Lewis a demonstration farm for peat soils has recently been successfully established as a part of the work of the new Macaulay Institute for Soil Research.

The beginnings of the Macaulay Institute date from June, 1928, when Mr. T. B. Macaulay of Montreal, a descendant of the Macaulays of Uig in the Island of Lewis, invited the cooperation of the Scottish Department of Agriculture in a plan for improving the agriculture of Lewis. As about nine-tenths of the Island consist of peat land, any attempt at improving the agriculture naturally involves the question of peat cultivation. Growing out of a report on peat culture in northern Europe by Mr. W. G. Coles and Dr. W. O. Ogg, who is now Director of the Institute, the work was organized and the project commenced in January, 1929, by the establishment of a farm on the Island of Lewis, or to give the Island its complete title, Lewis-with-Harris. The Island is 24 miles from the nearest point of the mainland; it is 60 miles long with a maximum breadth of 30 miles. The area is 492,800 acres and the total population 32,160, of which about one-third speak Gaelic only.

Working in these picturesque surroundings, the farm has already successfully demonstrated the best methods of reclaiming and farming peat land, the best methods of using pasture, and other activities in connection with the agriculture of the Island. Interesting is the statement in a report by Dr. Ogg which is reprinted from recent issues of the Scottish Journal of Agriculture,

"As the Island is almost treeless and subject to fierce gales, an attempt is being made to grow shelter belts." An echo of this is found in Michigan, where willow trees have been successfully used at the Experimental Field as shelter belts against wind. Dr. Ogg reports that "much still remains to be done, but in less than three years a very desolate tract of deep and wet peat land has been converted into a farm; an outstanding success has been the establishment of excellent pasture on which cows have been grazed for the past two summers."

In addition to the work actually conducted on the Island of Lewis, laboratories have been established on the mainland in association with the North of Scotland College of Agriculture at Aberdeen which also will give attention to other poorly utilized land in the north of Scotland. Hence in April, 1930, the Macaulay Institute was incorporated and laboratories and experimental grounds established at Craigiebuckler on the outskirts of Aberdeen and these, together with the farm at Lewis, constitute the Macaulay Institute for Soil Research. The property near Aberdeen consists of 50 acres of land well equipped for soil studies, two miles from the center of the city. Plans thoroughly grounded on research work, the results of which can be successfully applied in cultivating the poorer soils of northern Scotland, are under way.

Coming nearer home, valuable work on peat soils is in progress at many centres from the Pacific to the Atlantic. Among them are the well-known projects of Dr. F. J. Alway in Minnesota, Dr. Paul Harmer in Michigan, Dr. R. V. Allison at the Everglades Experiment Station, Belle Glade, Florida, and the work on the McGuffey Farm in Ohio started a year or so ago.

Several valuable papers have recently been published. Among them were three from the Department of Agronomy, Cornell University, and reprinted from the Journal of the American Society of Agronomy. The "Reaction and Calcium Content of Drainage Water from Peat Deposits in New York" by B. D. Wilson, E. V. Staker, and G. R. Townsend shows there is little doubt that the reaction of the ground water is influenced by the character of the material below the peat bed. Thus, if a peat deposit rests on calcareous or non-calcareous materials "appears to determine, to some degree at least, the relative acidity of the upper layers of the deposit and the reaction of the drainage water from the upper few feet of soil." Further notes on the principal types of peat soil under cultivation in New York State are given.

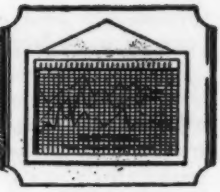
Another paper by T. K. Wilson and H. W. Higbee refers to "The Presence and Distribution of Sulfofying Bacteria in Mineral and Peat Soils," from which it is concluded that no one soil series was strikingly more efficient in supporting the sulfofying bacteria than was any other.

A third paper by B. D. Wilson and E. V. Staker refers to the important subject of the "Relation of Organic Matter to Organic Carbon in the Peat Soils of New York," from which it is concluded that "it is obvious that no factor could be selected that would apply to all of the soils of the present report if more than approximate values of the organic matter which they contain are desired." It is further suggested that a modification of the factor 1.86 for peat soils would seem to be necessary for the peat soils of New York State.

In a rational economy of land utilization, it is inevitable that peat soils will have a very important place in a crop production program. Strikingly enough the more we know about these soils, the more we find there is to know.

APOLOGY: We are sorry that we failed to extend courtesy credit to *Better Homes and Gardens* for the use of the cut of Dr. Liberty Hyde Bailey in our last issue.

AGRICULTURAL DEVELOPMENTS



CHEMIST'S STUDY OF AN AMERICAN WEED YIELDS IMPORTANT RESULTS

The discovery of rotenone—a very valuable insecticidal substance—in the devil's-shoestring, a weed of the pea family found in the United States from Minnesota to New England and as far south as Florida and eastern Texas, is announced by Dr. W. W. Skinner, assistant chief of chemical and technological research, Bureau of Chemistry and Soils. Heretofore rotenone has been obtained only from the foreign tropical plants Derris, a vine growing in the East Indies, and cubé, a South American shrub. Dr. E. P. Clark, a chemist of the insecticide division of the bureau, is named by Doctor Skinner as the scientist who made the discovery.

It is believed that this discovery will make it possible to obtain this valuable insecticidal material from a plant which can be grown easily in the United States, says Doctor Skinner.

About two years ago Professor V. A. Little, of the Texas Agricultural College, found that the devil's-shoestring had value as an insecticide, but the nature of the active principles remained unknown until chemists of the Bureau of Chemistry and Soils examined the plant.

The devil's-shoestring grows well on poor sandy soil, and it is believed it will prove a valuable crop on large areas of land not suited to other plants. The root is the part of the plant richest in insecticidal value; the amount of rotenone in the root, though small, equals that in certain species of Derris. Other constituents in the root raise the total content of insecticidally active material to 4 or 5 per cent. It is believed that by selection and cultivation this content can be increased.

Other species of American plants closely related to the devil's-shoestring are being studied by the bureau also. —*The Official Record.*

PECAN PRODUCTION

Texas produces from a fourth to a half of our total pecan crop, says the United States Department of Agriculture. Pecan trees are native to the South Central States, but plantings of improved varieties have been made on a large scale throughout the east Gulf and South Atlantic coastal plains. Nuts from improved varieties come mostly from the Southeastern States and nuts from seedling and wild trees come chiefly from States west of the Mississippi. Georgia frequently produces about two-fifths of the improved varieties and Texas and Oklahoma together usually produce from two-thirds to four-fifths of the seedling nuts. Total pecan production in the United States from 1927 to 1931 ranged from 35,000,000 to 77,000,000 pounds.

SOYBEANS BECOME NEW UNITED STATES EXPORT

Soybeans have become a new export of the United States.

Although the bean was introduced here from the Orient, its popularity has increased so rapidly that last year more than 2,100,000 bushels were exported, much of it to Germany, the United States Department of Agriculture says. This is the first time the

soybean has been exported from this country on a large commercial scale.

Problems encountered in shipping the beans gave growers and exporters helpful knowledge for future shipments, the department says. They found that the standard United States grades were acceptable to foreign buyers without question. They tried shipping beans in bags, but found the waste was greater than when shipped in bulk. Beans containing more than 14 per cent moisture can not be shipped safely. Beans dried in kilns were low in moisture content, but they split badly in handling, lowering the grade. The department believes kiln drying is feasible if carefully done.

USEFUL INSECT SENT ABROAD

A native North American parasite of proved value in fighting the oriental fruit moth, a destructive orchard pest, is becoming well established in France.

This useful parasite (*Macrocentrus ancylivorus*) was shipped abroad last year by the Bureau of Entomology, United States Department of Agriculture, in partial return for many courtesies that French authorities have shown American entomologists seeking natural enemies of insect pests for introduction into this country.

Adults reared from the parasitized moth larvæ shipped from the United States and released in infested orchards along the Mediterranean seem to have attacked the fruit moth very effectively.

WEEDS "DOMESTICATED" IN TOBACCO EXPERIMENTS

The United States Department of Agriculture is "domesticating" weeds in experiments in southern Maryland.

Unorthodox as it appears, growing weeds is useful in this instance. Experiments in that area showed that tobacco grown on land that grew weeds the previous year was higher in quality than that from land continually cropped.

In nature, a wide mixture of weeds grew, but in the experiments the department has planted individual plots of the more common weeds, such as ragweed, stickweed, partridge peas, and lamb's-quarter. Following the weed crop the department will plant tobacco on the plots and study its quality.

Weeds apparently thrive on opposition. Department scientists found that, although the weeds grew readily under natural conditions, they did not grow so readily when they were planted. The Government men had difficulty in making some of the weeds in the experiments grow at all.

Tobacco growers for many years have known something of the effect of weeds on a following tobacco crop, but in times of good prices they have been unwilling to let the land lie idle and grow weeds. Now, with too much tobacco, farmers who let part of their land grow to weeds one year may get better tobacco the next.

PROTEINS IN SOYBEANS DIFFER IN FEED VALUE

The livestock feeding value of soybeans is determined to a large extent by the type of protein which they contain and varies substantially for different varieties, chemists of the United States Department of Agriculture find.

Preliminary tests showed, for example, that the Illini variety of soybean has a protein which makes it valuable as a supplement for such feeds as corn and oats. To supplement such feeds as cow-peas, lentils, and peas, the Chiquita and Manchu soybeans were found to contain the best protein.

The department has collected many soybean varieties in the Orient and is testing them in this country. It plans further experiments to find the best feeding uses of each.

Massachusetts' Potato Club

By R. W. Donaldson

Extension Agronomist, Massachusetts State College, Amherst, Massachusetts

TO have three growers with potato yields over 600 bushels on a measured acre, and 44 farmers with acre-yields over 300 bushels growing 850 acres of spuds, marks 1932 as the banner season thus far of the Massachusetts Potato Club which started back in 1927.

The honor of achieving the highest record goes this year to W. P. Turner of North Reading, Massachusetts, with a yield of 634 bushels all weighed off from one acre of his crop.

On the well-fertilized tobacco soil of the Connecticut Valley was grown the next highest yield, 625 bushels, by A. E. Fowler of Westfield. To Mr. Fowler also goes the distinction of having the largest acreage of potatoes in the State. His potato crop occupied 140 acres, nearly all in a solid block on land, which for the most part grew shade tobacco the previous year.

Credit for the other 600-bushel yield goes to the town of Gill, the home of more champion growers in the Potato Club than any other town in Massachusetts. This time it was Joseph Zywina, who won third place for his home town with a yield of 617 bushels.

In addition to the three 600-bushel men, there were six others with yields between 500 and 600 bushels, while there were 26 others whose yields ran between 400 and 500 bushels. The remaining 11 men had yields between 300 and 400 bushels. Green Mountain was the variety grown.

Undoubtedly, one of the factors responsible for increasing yields of growers in this section is the tendency in recent years to use more seed to the acre and to adopt closer spacing in rows when planting the crop. Whereas formerly 12 to 14 bushels of seed were the common rates for planting an acre, the average amount of seed used by members of the Club this past year was 20 bushels. In several cases amounts as high as 27 and 28 bushels were used. In fact Mr. Fowler used 25

Six trips with the weeder during the growing season comprised the cultivation given the 467-bushel yield of potatoes grown by R. H. Sanford.

bushels as an average for his 140 acres, from which his 625-bushel yield was obtained. With increase in amount of seed used, closer spacing of seed pieces in the row has been adopted. This in turn has tended to reduce the tendency toward over-size and hollow-heart of tubers. Nine-inch spacing was used in Mr. Fowler's crop; while 11 and 12-inch spacings were observed by the majority of growers.

The practice of using nothing but certified seed stock having the lowest possible disease count is well established among growers in the Club.

The highest yield of potatoes was fertilized with a ton of 5-8-10. With few exceptions members in the Potato Club apply fertilizer to supply the equivalent of 1,800 to 2,500 pounds of single strength 4-8-7, 4-8-8, 4-8-10, or 5-8-10. Seven of the list used concentrated grades and a few of the larger growers home-mixed their own ingredients. Practically all growers have abandoned the earlier practice of splitting the fertilizer application. It is now all drilled at the time of planting.

Growers favor level culture rather than ridging except for the wetter soils. In most cases growers plant about three inches below the field surface, but aim to cover lightly to hasten sprout emergence and lessen the danger of stem-rot infection. Level culture methods are used during the early growth stages, followed by moderate ridging in the final operations. The operations in level culture are effective and cheaper, they find.

In fact two successful growers have used nothing but a tractor weeder to cultivate their potato crop between planting and digging. This year they spent only two hours total time per acre to do six weedings. And, without any ridging at all, they managed to roll out over 450 bushels per acre in each case. This method of "weeding" the crop took less than one-quarter the time averaged by other growers to cultivate and hill their crops.

Louisiana Tests Maine Potato Seed

DIVIDING a potato and growing part of it in Louisiana to test it for disease and the rest of it in Maine, if it is healthy in Louisiana, is the method the Bureau of Plant Industry, United States Department of Agriculture, has used to keep its experimental potato seed disease-free at Presque Isle, Me.

The practice, known as the tuber-index method, when conducted in the South makes it possible to observe the growing plants until they are mature, before planting time in the North, and diseased seed can be eliminated.

Last year several thousand carefully selected potatoes at Presque Isle were cut in four pieces each, two pieces of each put into a numbered bag and sent to the test plots at Houma, La., and the remaining two pieces put in a correspondingly numbered bag and kept at Presque Isle. These potatoes, covering nearly an acre, were grown at Houma, and as they grew they were inspected regularly for mosaic, leaf roll, splindle tuber, and other diseases by the Louisiana potato specialists. A record of all diseased plants was sent to Presque Isle and the corresponding pieces of seed there were discarded.

Tuber-index studies are sometimes made by planting the test pieces in a greenhouse, but the field method in the South has proved more satisfactory, as it allows a larger number to be studied and it is easier to let the plants grow to maturity outdoors than in the greenhouses.

The department has potato experiments in progress which require several years and it is essential that the seed be as nearly disease-free as possible.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture and the State Experiment Stations relating to Soils, Fertilizers, Economics, and Crops. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

Considerable variation in the natural productivity of Washington soils, which should be considered in fertilizer practices, is revealed by a large number of cooperative fertilizer tests in that State. This work, conducted over a period of five years, is reported and summarized by S. C. Vandecaveye and G. O. Baker in Washington Agricultural Experiment Station Bulletin 274, "The Effect of Fertilizers on Crop Yields of Different Soils and on the Composition of Certain Crops." Most of the soils studied responded profitably to fertilizers of some kind or other. Of particular interest were the results of the pasture tests. These showed that in most cases a complete fertilizer with lime gave the highest yields, with the largest amount per acre of protein, calcium, phosphorus, and potassium produced in the forage. It was especially noteworthy that the fertilizer treatments materially improved the quality of the herbage by influencing the kind of plants thriving in the pasture on some of the soils. The natural flora of the pasture was brome and fescue grasses and weeds. The use of a combination of phosphate, potash, and lime resulted in a pasture of about 40 per cent clover in two years. The authors conclude that: "The proper use of complete fertilizers on pastures on medium producing western Washington soils that are well supplied with moisture throughout the growing season or that can be irrigated economically during the dry season is a good farm practice, not only because it greatly increases crop yields, but also because it improves the quality of the pasture grasses and hay in regard to mineral content, notably that of calcium and phosphorus."

An interesting and highly practical series of experiments on strawberry fertilization is reported by R. A. Lineberry, J. J. Skinner, H. B. Mann, and C. B. Williams in Agronomy Information Circular No. 75 of the North Carolina Agricultural Experiment Station, entitled "Results of Strawberry Fertilizer and Tillage Experiments." Various fertilizer analyses, time and amount of applying fertilizers, and sources of plant food were among the items investigated on several soils in the State. A summarization of the results indicates that 1,500 pounds per acre of 6-8-6 (NH_3, P_2O_5, K_2O) fertilizer was the best under the conditions of this work. When all the fertilizer was applied in late summer or early fall, larger yields and earlier berries were produced than when half the fertilizer was applied in the summer and half in the winter. The ammonia in the fertilizer apparently should be partly organic and partly inorganic in origin. A comparison of the potash carriers did not indicate any material differences in their effects on yields. Concentrated fertilizers usually gave better results than ordinary strength fertilizers. The work in this preliminary report is being continued in order to obtain additional information and confirmation on the above and other points.

Sweet potato investigations conducted along lines similar to those mentioned above on strawberries are contained in United States Department of Agriculture Technical Bulletin 335, "Fertilizers for Sweet Potatoes Based on Investigations in North Carolina," by J. J. Skinner, C. B. Williams, and H. B. Mann. The best fertilizer analysis varied with the soil, but was usually one containing 3 to 4 per cent ammonia, 3 to 6 per cent phosphoric acid, and 8 to 10 per cent potash. The best amount to apply varied from 750 to 1,500 pounds per acre, depending on the soil. The ammonia apparently should be derived partly from inorganic and partly from organic carriers. Sulphate of potash was the best of the potash carriers, followed closely by muriate of potash, with kainit third, somewhat behind the muriate. It appeared that it was a little safer to apply the fertilizer broadcast on top of the ridge after the plant was established rather than in the row immediately before setting out the plants.

Sweet potato growers in North Carolina will find this bulletin very valuable in showing them the best practices to follow in fertilizing their crop; and growers in other sections probably also will be able to obtain suggestions as to practices they might try in their own localities.

"Commercial Fertilizers—Report for 1932," Agr. Exp. Sta., New Haven, Conn., Bul. 343, Nov., 1932, E. M. Bailey.

"Commercial Fertilizers, 1932," Ga. Dept. of Agr., Atlanta, Ga., Serial No. 122.

"Soils and Fertilizer Experiments, Experiment Station Farm, Lexington," Agr. Exp. Sta., Lexington, Ky., Bul. 331, July, 1932, Geo. Roberts and E. J. Kinney.

"Report of Analysis of Commercial Fertilizers," La. Dept. of Agr., Baton Rouge, La., Fert. Rept., Season 1931-32.

"Inspection of Commercial Fertilizers," Agr. Exp. Sta., Amherst, Mass., Control Series, Bul. 65, Oct., 1932, H. D. Haskins.

"Marl, Its Formation, Excavation, and Use," Agr. Exp. Sta., East Lansing, Mich., Spec. Bul. 224, June, 1932, S. G. Bergquist, H. H. Musselman, and C. E. Millar.

"The Composition of Soybean Plants at Various Growth Stages as Related to Their Rate of Decomposition and Use as Green Manure," Agr. Exp. Sta., Columbia, Mo., Res. Bul. 173, Sept., 1932, Lloyd M. Turk.

"Digest and Copy of the Fertilizer Law," Agr. Exp. Sta., New Brunswick, N. J., Cir. 260, Nov., 1932.

"Factors Affecting the Use of Nitrate and Ammonium Nitrogen by Apple Trees," Agr. Exp. Sta., New Brunswick, N. J., Bul. 547, Nov., 1932, V. A. Tiedjens and M. A. Blake.

"Analyses of Commercial Fertilizers, Fertilizer Supplies, and Home Mixtures for 1932," Agr. Exp. Sta., New Brunswick, N. J., Bul. 549, Nov., 1932, Charles S. Cathcart.

"The Management of Manure in Barn and Field," Ohio State Univ., Columbus, Ohio, Ext. Bul. 131, J. A. Slipher.

"Easily Soluble Phosphorus in Oklahoma Soils," Agr. Exp. Sta., Stillwater, Okla., Sta. Bul. 205, Sept., 1932, Horace J. Harper.

"Fertilizer Report, 1931," Pa. Dept. of Agr., Harrisburg, Pa., Gen. Bul. 513, Oct. 1, 1932, James W. Kellogg.

"Commercial Fertilizers in 1931-32 and Their Uses," Agr. Exp. Sta., College Station, Tex., Bul. 460, Oct., 1932, G. S. Fraps and S. E. Asbury.

"Commercial Fertilizers," Agr. Exp. Sta., Burlington, Vt., Bul. 345, Sept., 1932, L. S. Walker and E. F. Boyce.

"Commercial Fertilizers—1932," Wis. Dept. of Agr., Madison, Wis., Bul. 129, Jan., 1932, W. B. Griem.

Soils

"Water Requirements of Cotton on Sandy Loam Soils in Southern San Joaquin Valley," Agr. Exp. Sta., Berkeley, Calif., Bul. 537, Aug., 1932, S. H. Beckett and Carroll F. Dunshee.

"Soil Erosion in California: Its Prevention and Control," Agr. Exp. Sta., Berkeley, Calif., Bul. 538, Aug., 1932, Walter W. Weir.

"Profile Characteristics of New England Forest Soils," Agr. Exp. Sta., New Haven, Conn., Bul. 342, Sept., 1932, Herbert A. Lunt.

"Soil Fertility," Agr. Exp. Sta., Manhattan, Kan., Bul. 260, Sept., 1932, R. I. Throckmorton and F. L. Duley.

"A Microscopic Study of Certain Changes in the Microflora of Soil," Agr. Exp. Sta., Geneva, N. Y., Tech. Bul. 204, Sept., 1932, H. J. Conn.

"Soil Fertility and Sweet Clover Production in Oklahoma," Okla. A. & M. Col., Stillwater, Okla., Sta. Bul. 206, Sept., 1932, Horace J. Harper.

"Drainage of Land Overlying an Artesian Ground-water Reservoir," Agr. Exp. Sta., Logan, Utah, Bul. 242, Nov., 1932, O. W. Israelsen and W. W. McLaughlin.

"Report of the Chief of the Bureau of Chemistry and Soils," U. S. D. A., Washington, D. C., June 30, 1932, Henry G. Knight.

"Measuring the Salinity of Irrigation Waters

and of Soil Solutions with the Wheatstone Bridge," U. S. D. A., Washington, D. C., Cir. 232, July, 1932, Carl S. Scofield.

"Physical and Chemical Characteristics of the Soils From the Erosion Experiment Stations," U. S. D. A., Washington, D. C., Tech. Bul. 316, June, 1932, H. E. Middleton, C. S. Slater, and Horace G. Byers.

"A Critical Laboratory Review of Methods of Determining Organic Matter and Carbonates in Soil," U. S. D. A., Washington, D. C., Tech. Bul. 317, June, 1932, Lyle T. Alexander and Horace G. Byers.

"The Fractionation, Composition, and Hypothetical Constitution of Certain Colloids Derived from the Great Soil Groups," U. S. D. A., Washington, D. C., Tech. Bul. 319, Irvin C. Brown and Horace G. Byers.

"Soil Survey of The Greeley Area, Colorado," U. S. D. A., Washington, D. C., Series 1929, No. 5, A. T. Sweet, L. A. Brown, and W E. Haines.

"Soil Survey of Polk County, Florida," U. S. D. A., Washington, D. C., Series 1927, No. 39, Earl D. Fowler, Arthur E. Taylor, E. W. Knobel, S. W. Phillips, F. R. Lesh, A. L. Gray, A. T. Sweet, M. J. Edwards, H. M. Smith, R. E. Devereux, A. H. Hasty, and Robert Wildermuth.

"Soil Survey of McIntosh County, Georgia," U. S. D. A., Washington, D. C., Series 1929, No. 6, G. L. Fuller, B. H. Hendrickson, and J. W. Moon.

"Soil Survey of Sac County, Iowa," U. S. D. A., Washington, D. C., Series 1928, No. 24, C. L. Orrben, A. L. Gray, and W. C. Boatright.

"Soil Survey of Mille Lacs County, Minnesota," U. S. D. A., Washington, D. C., Series 1927, No. 37, G. B. Bodman, C. H. Hammar, S. Hill, T. H. Mather, H. T. Petraborg, J. W. Moon, A H. Hasty, and J. H. Zentmire.

"Soil Survey of The Milk River Area, Montana," U. S. D. A., Washington, D. C., Series 1928, No. 22, William DeYoung, F. O. Youngs, and T. W. Glassey.

"Soil Survey of Vernon County, Wisconsin," U. S. D. A., Washington, D. C., Series 1928, No. 21, M. J. Edwards, A. C. Anderson, A H. Meyer, J. A. Chucka, and D. E. Wilcox.

Crops

Fifteen annual reports of agricultural experiment stations are included in the following publications. Coming into circulation at the beginning of a new agricultural year, these summaries of advancement in the science of the industry form important additions to the published information on agriculture.

"Forty-third Annual Report for the Year Ended June 30, 1932," Agr. Exp. Sta., Tucson, Ariz.

"Seventeenth Annual Report for the Fiscal Year Ended June 30, 1931," Agr. Ext. Serv., Tucson, Ariz., Ext. Proj. Cir. 12, Sept., 1932, P. H. Ross.

"Cotton Variety Tests," Agr. Exp. Sta., Fayetteville, Ark., Bul. 282, Nov., 1932, J. O. Ware.

"Tomato Production in California," Univ. of Cal., Berkeley, Calif., Ext. Cir. 66, Oct., 1932, O. H. Pearson and D. R. Porter.

"The Forty-fifth Annual Report of The Colorado Agricultural Experiment Station for the Fiscal Year 1931-32," Agr. Col., Fort Collins, Colo.

"Lawn Seeding and Care," Agr. Exp. Sta., New Haven, Conn., Cir. 83, Mar., 1932.

"Red Raspberry Culture in Connecticut," Agr. Col., Storrs, Conn., Ext. Bul. 172, June, 1932, H. R. Rollins.

"Chemical Investigations of the Tobacco Plant—III. Tobacco Seed," Agr. Exp. Sta., New Haven, Conn., Bul. 339, June, 1932.

"A New Wheat for Georgia," Exp. Sta., Experiment, Ga., Bul. 171, Aug., 1932, R. P. Bledsoe.

"Work and Progress of The Agricultural Experiment Station for the Year Ending December 31, 1931," Agr. Exp. Sta., Moscow, Idaho, Bul. 192, May, 1932.

"The Extension Service in Agriculture and Home Economics, 1933," Agr. Exp. Sta., Urbana, Ill., Ext. Cir. 398, Oct., 1932.

"Korean Lespedeza," Agr. Exp. Sta., Manhattan, Kan., Cir. 163, Jan., 1932, A. E. Aldous.

"The Identification of Certain Native and Naturalized Grasses by Their Vegetative Characters," Agr. Exp. Sta., Manhattan, Kan., Tech. Bul. 32, March, 1932, F. F. Copple and A. E. Aldous.

"Forty-fourth Annual Report of the Agricultural Experiment Station of the University of Kentucky for the Year 1931," Agr. Exp. Sta., Lexington, Ky.

"Tobacco Project Junior 4-H Clubs," Univ. of Ky., Lexington, Ky., Ext. Cir. 86 (2d Rev.), Jan., 1932, E. J. Kinney.

"Tobacco Diseases in Kentucky," Agr. Exp. Sta., Lexington, Ky., Bul. 328, Mar., 1932, W. D. Valleau and E. M. Johnson.

"Starting Plants Under Glass," Univ. of Me., Orono, Me., Ext. Bul. 206, Nov., 1932, Richard M. Riley.

"Progress of Investigations, Abstracts of Papers Not Included in Bulletins, Finances, Meteorology, Index," Agr. Exp. Sta., Orono, Me., Bul. 360, Dec., 1931.

"The Vegetative Propagation of Plants," Agr. Exp. Sta., College Park, Md., Bul. 335, June, 1932, F. E. Gardner.

"Asparagus and Its Culture," State College, Amherst, Mass., Ext. Leaflet 49, (Rev.), Apr., 1932.

"Agricultural Experiment Station Report—Two Years Ended June 30, 1932," Mich. State Col., East Lansing, Mich.

"Field Peas for the Upper Peninsula of Michigan," Agr. Exp. Sta., East Lansing, Mich., Cir. Bul. 145, Nov., 1932, B. R. Churchill.

"The Quarterly Bulletin," Agr. Exp. Sta., East Lansing, Mich., Vol. XV, No. 2, Nov., 1932.

"Blackberries and Raspberries," Univ. of Mo., Columbia, Mo., Ext. Cir. 294, Nov., 1932, H. G. Swartwont.

"Agricultural Research, Its Service to the State—Thirty-eighth Annual Report of the Agricultural Experiment Station, July 1, 1930, to June 30, 1931," Agr. Exp. Sta., Bozeman, Mont., F. B. Linfield.

"Oat and Barley Varieties Under Irrigation," Agr. Exp. Sta., Bozeman, Mont., Bul. 206, Aug., 1932, J. E. Norton and LeRoy Powers.

"Potato Growing in New York," N. Y. State Col. of Agr., Ithaca, N. Y., Ext. Bul. 239, Aug., 1932, E. V. Hardenburg.

"Fifty-first Annual Report for the Fiscal Year Ended June 30, 1932," Agr. Exp. Sta., Geneva, N. Y., U. P. Hedrick.

"Suggestions to Tobacco Growers in North Carolina for 1933," State Col. of Agr., Raleigh, N. C., Ext. Folder 33, Dec., 1932, E. Y. Floyd.

"Lespedeza in North Carolina," State Col. of Agr., Raleigh, N. C., Ext. Cir. 195, Jan., 1933, E. C. Blair.

"Experiments with Growing Corn and Soybeans in Combination," Agr. Exp. Sta., Wooster, Ohio, Bul. 513, Oct., 1932, H. L. Borst and J. B. Park.

"Fifty-first Annual Report, 1931-1932," Agr. Exp. Sta., Wooster, Ohio, Bul. 516, Jan., 1933.

"The Bimonthly Bulletin," Agr. Exp. Sta., Wooster, Ohio, Vol. XVIII, No. 1, Jan.-Feb., 1933.

"The Pennsylvania Agricultural Experiment Station-45th Annual Report, for the Fiscal Year Ended June 30, 1932," Agr. Exp. Sta., State College, Pa., Bul. 279, Aug., 1932.

"Forth-fifth Annual Report of the South Carolina Experiment Station of Clemson Agricultural College, for the Year Ended June 30, 1932," Agr. Col., Clemson College, S. C., Dec., 1932, H. W. Barre.

"Bermuda Onion Culture in Texas," Agr. Exp. Sta., College Sta., Tex., Cir. 65, Nov., 1932, Leslie R. Hawthorn.

"Spinach Under Irrigation in Texas," Agr. Exp. Sta., College Sta., Tex., Cir. 66, Nov., 1932, Leslie R. Hawthorn.

"Fig Culture in the Gulf Coast Region of Texas," Agr. Exp. Sta., College Sta., Tex., Bul. 466, Dec., 1932, R. H. Stansel and R. H. Wyche.

"The Agriculture and Forestry of Vermont," Univ. of Vt., Burlington, Vt., Ext. Cir. 66, June, 1931, J. E. Carrigan.

"Seventeenth Annual Report of Cooperative Extension Work in Agriculture and Home Economics, for the Fiscal Year Ending June 30, 1931," Univ. of Vt., Burlington, Vt., Ext. Bul. 17, June, 1932, J. E. Carrigan.

"Forty-fifth Annual Report, 1931-1932," Agr. Exp. Sta., Burlington, Vt., Bul. 344, July, 1932, J. L. Hills.

"Forty-second Annual Report, for the Fiscal Year Ended June 30, 1932," Agr. Exp. Sta., Pullman, Wash., Bul. 275, Dec., 1932.

"Adaptation of Fiber Flax to the South Atlantic States," U. S. D. A., Washington, D. C., Cir. 231, June, 1932, B. B. Robinson and T. B. Hutcheson.

"Variety Tests of Sugarcanes in Louisiana During the Crop Year 1930-31," U. S. D. A., Washington, D. C., Cir. 242, Sept., 1932, George Arceneaux, I. E. Stokes, and R. B. Bisland.

"Growing Fruit for Home Use in the Great Plains Area," U. S. D. A., Washington, D. C., Farmers' Bul. 727 (Rev.), May, 1932, H. P. Gould and Oliver J. Grace.

"Response of Sweet Corn to Varying Temperatures from Time of Planting to Canning Maturity," U. S. D. A., Washington, D. C., Tech. Bul. 312, June, 1932, C. A. Magoon and Charles W. Culpepper.

Economics

"Development of Agricultural Credit Corporations in Arkansas with State Aid in 1931," Agr. Exp. Sta., Fayetteville, Ark., Bul. 281, Oct., 1932, B. M. Gile.

"Operating Practices of Farmers' Cooperative Elevators in Colorado," Agr. Exp. Sta., Fort Collins, Colo., Bul. 397, Oct., 1932, D. N. Donaldson and Perry V. Hemphill.

"Economic Facts for Georgia Farmers—Georgia Agricultural Outlook for 1933," Univ. of Ga., Athens, Ga., Vol. XXI, Ext. Cir. 210, Dec., 1932.

"Factors for Success on Dairy and General Farms in Northern Livingston County, New York," N. Y. State Col. of Agr., Ithaca, N. Y., Ext. Bul. 242, Oct., 1932, Stanley Whitson Warren.

"An Economic Study of Agriculture in Northern Livingston County, New York," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., Bul. 539, May, 1932, Stanley Whitson Warren.

"Agricultural Outlook for 1933," State Col. of Agr., Raleigh, N. C., Ext. Cir. 194, Dec., 1932.

"Land Utilization in Lawrence County, Ohio," Agr. Exp. Sta., Wooster, Ohio, Bul. 514, Nov., 1932, J. H. Sitterley, H. R. Moore, and J. I. Falconer.

"Marketing Pennsylvania Potatoes in Fifteen-pound Containers," Agr Exp. Sta., State College, Pa., Bul. 281, Oct., 1932, T. K. Cowden.

"A Farm Management Survey of Tioga County, Pennsylvania," Agr. Exp. Sta., State College, Pa., Bul. 282, Nov., 1932, J. E. McCord.

"Relation of Price to Quality of South Carolina Cotton 1929-1930 Season," Agr. Exp.

Sta., Clemson College, S. C., Bul. 279, Aug., 1931, Marvin Guin.

"The Business Situation in Relation to Agriculture," State Col. of Wash., Pullman, Wash., Timely Economic Information for Wash. Farmers, No. 12, Nov., 1932.

"A Simple Way to Increase Crop Yields," U. S. D. A., Washington, D. C., Farmers' Bul. 924 (Rev.) Nov., 1932, H. A. Miller.

"High-grade Alfalfa Hay," U. S. D. A., Washington, D. C., Farmers' Bul. 1539, Oct., 1932, Edward C. Parker.

"Adequacy and Reliability of Crop-yield Estimates," U. S. D. A., Washington, D. C., Tech. Bul. 311, June, 1932, Charles F. Sarle.

"Making the Most of Washburn County Land," Col. of Agr., Madison, Wis., Special Cir., Oct., 1932.

Six Bushels for One

(*From page* 28)

Hammond was given a clew as to what had been his trouble in growing crops on this land during the 25 years or more that it had been cleared. On this date a study of corn and soybeans growing on this land was made after Mr. Hammond had sent out an S. O. S. relative to the matter. (BETTER CROPS WITH PLANT FOOD, *page* 13, *April-May*, 1932.)

The blades of corn were yellow, dead around the margins, and when the stalk was cut at the crown of the roots, root rot was found. In some sections "frenching" is the term used to designate this condition. Soybeans growing near the corn were 10 inches tall, yellow, and had lost a good portion of their leaves. The beans had received 500 pounds of basic slag per acre, and hence, it was established that phosphorus alone would not correct the condition. The corn had had no fertilizer applied to it.

It was decided that these crops were starved for potash. But with the season so far advanced, doubt was expressed as to whether potash would do any material good if applied to the crops at this late date. However, Mr. Hammond, who had puzzled over this area for so many years, wanted to go ahead and try potash on these crops anyway.

The next day he applied 100 pounds of muriate of potash to an acre of the corn, and 250 pounds of high grade kainit (20%) to an acre of the soybeans. Only small showers occurred between the time of applying the potash materials and the dates of harvesting the crops.

The increases in yields from the potash applications were remarkable. The 100 pounds of muriate of potash increased the corn yield 120 per cent, while the 250 pounds of 20 per cent kainit on the soybeans increased the yield of hay by slightly more than 42 per cent.

It is no wonder that Mr. Hammond applied 100 pounds of muriate of potash per acre just prior to planting corn on this area in the spring of 1932. It was thought that an application of phosphate along with the potash would help the corn, and so Mr. Hammond mixed 100 pounds of 16 per cent superphosphate with each 100 pounds of muriate of potash he applied to this corn. The profits that this fertilizer combination gave have already been given.

The land on which this corn grew is grayish colored, and is closely related to other gray, yellowish gray, and yellow colored soils in the valleys of northern Alabama. These are sometimes referred to as Flatwoods soils, of which there are hundreds of thousands of acres in Alabama, being composed of the Conasauga, Colbert, and Hollywood soil groups.

Fertilizer tests show that all crops on these soils, and similar soils in Georgia and the Carolinas, should receive relatively large amounts of potash.

Fertilizing Bulbs

By George R. Cobb

Salisbury, Maryland

NO other class of flowering plants has grown so rapidly in popular favor, during recent years, as has bulbs, writes F. F. Rockwell, in his book entitled, *The Book of Bulbs*. He adds that home production and importation from abroad have both grown at a tremendous rate, and yet they have hardly sufficed to satisfy the ever-increasing army of bulb users.

The Corona Nurseries, Inc., located near Salisbury, Maryland, although established only three years, have over 2,000,000 gladioli and a like number of narcissi, in addition to thousands of tulips, irises, and spireas. Based on actual acreage, there are more than 30 acres devoted to gladioli, 30 acres to narcissi, two acres each in irises, tulips, and spireas. Incidentally the work with tulips is still in the experimental stage.

A million means but little to the average person, but when it is realized that the number of bulbs at the Corona Nurseries—4,000,000—if placed four inches apart in a row would reach over 253 miles, the size of the undertaking more readily can be appreciated.

Several problems presented themselves to Mr. John Langeler, the superintendent, when operations were started, but results show that he has met and solved them, to a degree, at least. Mr. Langeler, like most efficient persons, is of the modest type and disclaims any credit, as he suggests that other nurserymen have achieved greater success. But with the success he already has attained, it is apparent that he will experience much greater achievements.

Soil requirements vary somewhat for different bulbs, but level land that is well drained is essential both for ease of labor and healthy bulbs. The land on which the Corona Nurseries are located fulfilled the two requirements mentioned above, but was sadly lacking in humus, being a light sandy soil of the Sassafras type.

In describing the cultivation and fertilization practices employed at the Corona Nursery, the point should be emphasized that neither Mr. Langeler nor his associates claim that their practices are the best or that other bulb growers, be they professional or amateur, should follow their system.

One of the first things a visitor notices at the Corona Nurseries is that the land is divided by windbreaks into many comparatively small fields. These windbreaks are of pine, but an established hedge of privet or some other hedge material would be preferable. It is of prime importance, according to Mr. Langeler, that windbreaks be provided.

If the visitor arrives during the winter or very early spring, the fact that rye is planted extensively is evident even at a distance. This crop has a two-fold purpose in that it prevents the soil from blowing during the winter, and when turned under green in the early spring, it adds a certain amount of humus to the soil. But rye should be turned under before it begins to joint, as after that it becomes more or less "woody" and decays very slowly.

After the rye has been turned under and the land thoroughly prepared,

a vigorous growing type of soybeans, Mammouth Yellow, Brown, or Black, is seeded. At the same time 800 pounds of bone-meal per acre are applied, to supply phosphorus to the growing crop. The soybeans are allowed to grow until the latter part of August when they are plowed or turned under, thus adding more humus and a considerable amount of nitrogen to the soil.

It will be noticed by the reader that at this time two of the essential plant foods have been supplied, namely, nitrogen and phosphorus. The other member of the trio is applied during the winter. In December or January, 1,000 pounds of sulphate of potash magnesia per acre are applied broadcast. Thus the three essential plant foods have been applied: nitrogen in form of soybeans, which it is claimed, contain 35 pounds of nitrogen in each ton of plants; phosphorus in bone-meal; and potash in sulphate of potash magnesia.

Sulphate of potash magnesia, one of the many forms of potash available to plant growers, farmers, or gardeners, is a double salt of potash and magnesia and contains not less than 25 per cent of actual potash, not less than 25 per cent of sulphate of magnesia, and not more than 2.5 per cent of chlorine.

Soils on the DelMarVa Peninsula, home of the Corona Nurseries, Inc., are beginning to show a lack of magnesia in some cases. Thus Mr. Langeler, through his experiences in Holland, hopes to supply sufficent magnesia for the needs of the bulb as well as plenty of potash to mature a large-sized bulb and one that will keep in storage and start vigorously when planted.

The office of the bulb, according to L. H. Bailey, is to carry the plant over an unpropitious season, as over winter or a dry period. The bulb, he continues, contains a new plant which is protected and sustained within the bulb by the reserve food and energy collected therein during the preceding season.

In addition to the plant food necessary to produce leaf and flower growth, there must be enough so that the new plant, inside the bulb, may store up some. But this stored plant food will not carry the plant through the following season and the "size, luxuriance, and brilliancy this season depends largely upon the nutrition the roots receive."

The use of high-potash fertilizers, in bulb growing, has given larger bulbs, more solid bulbs, a better keeper in storage, a bulb that will start earlier, and a bulb that has stored up plenty of reserve food. Another factor that is essential in bulb growing is early maturity, and Mr. Lange-

A row of pines have been planted to serve these tulips as a windbreak.

ler states that the large amount of potash he is using per acre has a tendency to hasten maturity and thus cut down the cost of harvesting. He noted that in 1928, when no potash was used, that it took his crew 10 days to harvest the crop of bulbs, but in 1929, with potash, the same sized crew harvested more bulbs in a shorter time.

Potash-Hungry Crops

(*From page* 21)

studies on asparagus, begun at the Sandhill branch of the South Carolina Experiment Station in 1931, has great promise since most of the "grass" grown in the Southeastern States is grown on the sandhill types of soil. However, tests that have run eight years on sandy bottom soil at the Clemson headquarters of the station show the interesting fact that lack of potash causes greatest decrease in yield of grass, lack of nitrogen next, and lack of phosphoric acid least. Average results indicate that the best analysis for a "grass" fertilizer is a 5-7-5 (NPK) and that about one ton per acre produces more profitable returns than ½ or 1½ tons.

Another kind of hunger of plants that is leading research men into interesting and valuable "finds" is magnesium hunger. Something about magnesium deficiency in tobacco, commonly called "sand-drown," was learned in recent years and tobacco specialists found that this sand-drown could be "cured" by feeding the plants magnesium, the usual recommendation being two per cent of MgO in the tobacco fertilizer to be derived from any material containing readily available forms of magnesium, such as sulphate of potash-magnesia and magnesium sulphate.

In other crops (including cotton, corn, sorghum, cowpeas, soybeans, and grapes) recent studies in South Carolina show that magnesium deficiency is prevalent on many farms, especially where there are gray sandy soils. The symptoms of this magnesium hunger are rather characteristic for the various crops, though it is sometimes difficult to differentiate between magnesium deficiency symptoms and other conditions determined by genetic factors or by maturity of the plant when growth ceases.

In cotton, magnesium hunger is indicated in red, purplish leaves with green veins, and there seems to be a definite relation between the deficiency and the source of nitrogen in the fertilizer. In a source-of-nitrogen test the deficiency symptoms were much more pronounced on sodium nitrate and ammonium sulphate plots than on ammoniated superphosphate and ammo-phos plots. It seems to hinge on the solubility of the magnesium salts formed by the addition of the various nitrogen carriers, says Dr. H. P. Cooper, agronomist of the station, who has charge of these studies.

In corn, magnesium deficiency is manifested by a striping of the leaf, a light green color between the veins fading into yellowish-white or yellowish-brown. Similarly in sorghums, except that the stripe is dark purple. In legumes the symptoms are a light green to yellowish color between the veins. In grapes there is a yellowish-white color between green areas around the veins.

Control of magnesium hunger in these crops has been found in the addition of available magnesium compounds to the soil. Soluble salts such as magnesium sulphate and sulphate of potash-magnesia are used, and a 1,500-pound broadcast application of dolomitic limestone per acre has been effective with a number of crops.

Quit Wondering

(*From page 27*)

tilization totaled about a ton of 5-7-5, with 1,000 pounds in early February and another thousand pounds in early June, the additional potash being used in July. The demonstration was two acres in size, being divided into four half-acre plots, two being checks with only the regular fertilization, the other two having the additional muriate of potash. In the spring of 1930, the second cutting season of the "grass," the high-potash plots showed an increase of 119 bunches per acre over the low-potash plots. The third cutting season, 1931, with a much larger gross yield than ever before, the high-potash plots led the others by 238 bunches.

In making a statement about his work, Mr. Cave says: "Asparagus is such a gross feeder on potash, that I'm wondering whether I shouldn't put even more than the 500 pounds of muriate of potash on the crop for its fifth cutting season. It looks as though the larger the root system gets, the larger its capacity for assimilating potash becomes. I shall try a few rows in my field next season, applying muriate at the rate of 1,000 pounds per acre, and will watch results with a great deal of interest."

Better Quality in Sauerkraut

(*From page 30*)

bage and the quality of the sauerkraut. This is especially true of the mineral content of the cabbage. However, there does seem to exist some correlation between the sugar content of the cabbage and the quality of kraut. As previously mentioned, the cabbage must have accumulated at least three per cent sugar in order that the necessary amount of lactic acid be produced in the kraut.

This accumulation of sugar takes place when the growth rate of the plant slows down and the sugars which are manufactured in the green leaves are stored in increasing amounts

The Clyde Kraut Company, Clyde, Ohio, uses a canvas cover for cabbage seedlings. This photograph was taken June 5, 1930.

within the head instead of being entirely re-utilized by the enlarging of the exterior foliage. The leaves of the head expand with this accumulation process and make for the solidity of the cabbage. And as the solidity of the head increases, the greenness disappears from the interior leaves. Under some conditions this process of storage may proceed too far. As cited in the first lot of cabbage mentioned, sugars had not only accumulated but had in part been converted into an excess of cell-wall material which caused the leathery texture of the kraut.

In the case of the cabbage which was starving for potash, the accumulation of sugar did not appear to be a limiting factor. This cabbage contained an excess of nitrate and other soluble nitrogen as compared with cabbage which produced good kraut. It is suggested that this excess of nitrate nitrogen in the cabbage might be responsible for the somewhat bitter taste of the kraut. The greenness of the cabbage, which causes dark-colored kraut, is related to the high content of soluble nitrogen. The softness of the tissues is related to the fact that too much of the nitrogen and sugar remained soluble, while too little elaborated material (proteins, starches, cellulose) was produced. This indicates the rôle of potash to be somewhat that of a regulator. Its presence tends to avoid the harmful effects that an excess of nitrogen might have upon the kraut cabbage, to say nothing of its ability to increase markedly the yield on certain soils.

The absence or presence of phosphorus does not seem to have any effect on the quality of kraut cabbage. To be sure, the absence of phosphorus will usually seriously lower the yield, but it does not seem to influence the chemical activities within the plant to the extent that potash does.

Assuming the presence of an adequate supply of water, good kraut cabbage should be grown with a plentiful supply of phosphorus and potash, and sufficient nitrogen, but not an excess, to keep it in good growth.

Yield and Quality

(*From page* 18)

son, he may get to see their tuber-unit experimental farm. Traveling up the St. John river more than 15 miles by canoe, you are landed near their forest-enclosed farm. Here the tuber-unit enterprise is carried on to perfection. In this work they have the close cooperation of the Maine Experiment Station. The units are harvested by hand, and the best ones are placed in paper bags. Only the tubers having the desired type and largest weight are used in the tuber-unit plot the next year. The rest of the seed are planted in the general field. From their best selections each year more than 80 acres of certified Green Mountain seed are grown.

To relate how the Daigle Brothers are putting business methods into their farming operations without telling something of the other side of their life would be unfair to them. Both of these enterprising young farmers find time to play some part in community activities. Albert is a member of the executive committee of the Aroostook county Farm Bureau in the capacity of Potato Project Leader for Northern Aroostook. David is a member and project leader of the local bureau and is also on the Board of Selectmen. Into these community activities they put the same untiring energy and enthusiasm which have made their experiments with tuber-unit seed plots and fertilizers so satisfying and profitable on their own farms.

Fertilizing the Citrus Grove

(*From page 8*)

devitalized. Often dry weather prevents the proper absorption of applied materials in time to keep the grove from getting into a slump following a heavy crop.

With weather frequently upsetting the "apple cart," we cannot, therefore, properly time fertilizer applications. Then, too, on account of market conditions, fruit is frequently allowed to remain on the trees from 30 to 90 days overtime, and unless this extra drain is allowed for, the trees are likely to either miss or bear a small crop the following year.

If the moisture supply were dependable, and the fruit moved to market when mature, we could better maintain the proper balance between the vegetative and fruiting tendency of citrus trees. This balance could be maintained by applying the proper ratio of potash and nitrogen, increasing the potash for fruit and increasing the nitrogen for growth—applying the nitrogen in fairly liberal amounts to trees in poor growth and applying liberal potash to trees in a vegetative condition.

When the objective becomes heavy crops of quality fruit year after year, growers seldom realize the amount of plant food that is being removed. It has become a maintenance problem. Therefore, it is well to know that citrus fruits demand from the soil the three principal plant foods in the following ratio: 4-1-5.2 (NPK). More potash is removed in a box of oranges or grapefruit than both phosphorus and nitrogen combined. If the grove is to be kept fruiting heavily year after year, these plant foods must necessarily be available to the tree. The question is: What amount of these materials can we depend on from the soil or through cover crops?

Florida's grove soils on the whole are relatively poor. Once the bed of the ocean, they are very sandy and the long, hot summers together with the loose texture of the soil prevent the building up of a very large organic matter content. They are especially deficient in potash. Hence, proper citrus fertilization consists in providing both for growth and fruiting, and in replacing those plant foods removed from the soil. On a replacement basis, the grower must use a fertilizer rich in the necessary plant foods so that his trees may by their selective power utilize those essential to the production of quality fruit.

Even before the orange blossoms have opened, growers must protect their trees, stem, leaf and all, with sprays or dusts. Here in this semi-tropical climate, with plenty of moisture, ravages of insects and diseases are in operation all the time. It requires almost a constant coverage to keep the fruit bright and in condition to top the market.

Following Sweet Clover

(*From page 6*)

been applied, (b) two crops of sweet clover for each rotation had been grown, and (c) after the discontinuance of the practice of returning straw to the land.

On the sweet clover plots where no potash is applied, the leaves of the corn turn brown along the edges, and in the worst cases, the whole plant appears badly diseased. Lodging of the corn, even though it is only three or four feet high, occurs throughout the plot. The application of potash results in the growth of corn of normal appearance.

On the untreated land, that is, land

where no sweet clover has grown, the corn fails to make a large growth, but there are none of the symptoms of diseased conditions such as were mentioned above.

The potash-deficiency symptoms appear to be associated directly with the sweet clover crop. On "Poorland Farm" in Marion county in 1927, one of the fields which had received uniform treatment was divided into two portions, one of which was seeded to sweet clover and the other to wheat. Due to winter-killing, the wheat was a failure and the whole field was planted to corn in 1928. Typical potash-deficiency symptoms, including lodging, were pronounced on the half which had grown the sweet clover, while there was no evidence of such a condition on the other half.

On another farm in the same county corn showed the typical potash-starvation symptoms the year sweet clover was used as a green manure, whereas there was no lodging of corn the following year in the same field either with or without potash. Thus corn a year removed from sweet clover showed no potash deficiency.

Even though the growth of the sweet clover is increased by the use of potash, this crop does well without this treatment. Analyses show that the sweet clover which is plowed under contains potassium sufficient to produce much more corn than is now grown on the plots without the addition of potash salts.

If one only considers that the response of corn to potash fertilization occurs after the removal of large crops resulting from the use of sweet clover, it might be concluded that the deficiency of potash results from a depletion of the limited amount of available potassium which the soil contains. When it is remembered, however, that the condition of the corn on the sweet clover plots without potash indicates a toxicity as well as a deficiency of plant-food elements; that in both field and laboratory trials, the marked benefits of potash are associated closely with the growing of sweet clover; that the sweet clover contains sufficient potassium to grow a good crop of corn, it appears that a biological factor in addition to a deficiency of available potassium must be considered.

It is believed that this factor is available nitrogen and that under conditions of low supplies of available potassium the excessive production of nitrate nitrogen may result in a condition unfavorable for the growth of corn. Therefore, it may be inferred that a favorable nitrate-nitrogen-potash ratio is important, and that under conditions of low availability of potassium, the accumulation of nitrate nitrogen may have a detrimental effect. Further investigations upon the function of potassium in plant metabolism should aid in establishing the relationship involved.

From our investigations thus far, the practical farmer may properly conclude that sweet clover is a valuable part of a good crop rotation but on many soils, an additional treatment of potash is needed to enhance its value.

Better Raspberries

(*From page* 13)

potash fertilizer mixture as to production and yield of fruit.

Mr. Insley had been applying a 7-6-5 commercial fertilizer mixture to the raspberry crop and had not applied much lime. When the soil was tested for acidity, a low pH indicated that lack of lime might have some bearing on low yields and possibly on the amount of die-back. The tests were, therefore, laid out so as to include lime and no lime as well as

POTASH INCREASED YIELDS

	Fertilizer	Amount per acre	Lime	Yields in quarts
1	7-6-5	1,000 lbs.	None	774
2	7-6-5	1,000 lbs.	2,000 lbs.	843
3	4-8-10	1,000 lbs.	None	1,152
4	4-8-10	1,000 lbs.	2,000 lbs.	1,998

different amounts and analyses of fertilizers.

A 4-8-10 fertilizer was chosen as a high potash mixture to compare with the 7-6-5 that was being applied. This analysis was applied in several plots together with lime, while on other plots no lime was applied.

These tests were supervised by Dr. R. A. Jehle, Extension Plant Pathologist of the University of Maryland, and County Agent James P. Brown, Salisbury, Maryland. Cane measurements together with a "diagnosis" of cane troubles were made by Dr. Jehle, while yields were checked by the writer and Mr. Insley.

It will be noted from the table that although lime increased yields considerably, the increased yields accompanying the use of a higher potash mixture were greater, in proportion, than the increases due to the application of lime.

The fact that red raspberries respond to applications of potash is borne out by several investigations, the latest probably being results secured by A. E. Stene, Pomologist at the Rhode Island Experiment Station and published in Bulletin 229, issued in August, 1931.

Mr. Stene states in this bulletin, "The best yield of red raspberries has been secured from a fertilizer containing all three elements, nitrogen, phosphoric acid, and potash. Leaving potash out of the fertilizer reduced the total yield for three seasons to less than one-half of that harvested from the plot receiving a "complete" fertilizer. Leaving out nitrogen reduced the yield about 30 per cent, and omitting phosphoric acid about 20 per cent, from the yield obtained with a complete fertilizer."

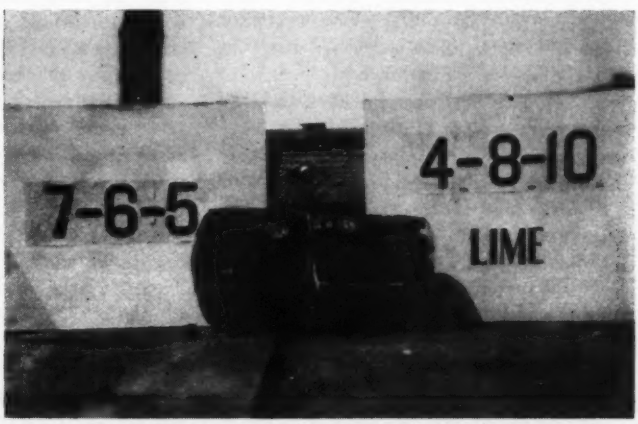
Summary of yields, per plot in grams, 1928-29-30.

NP	24,110
PK	35,506
NK	42,327
NPK	51,067

In determining the amount of die-back in each Maryland plot, actual measurements were taken of 40 plants in each row, the number of canes totaled together with the amount of die-back rated as slight, one-half dead, and completely dead.

The following table gives results of the tests based on an acre basis—5,000 plants to the acre.

Although only a one-year test, the results are so outstanding that there



Note the difference in size of berries when fertilized with high potash and lime.

Plot	Total canes	Average length of cane	Total of bearing wood	Total canes dead
7-6-5	36,500	23 inches	69,958 feet	14,500
4-8-10	41,000	37 inches	126,500 feet	2,500

would seem to be no doubt but that higher potash mixtures will increase yields of red raspberries and decrease the amount of die-back under the conditions that existed where the work was conducted.

As the "proof of the pudding is in the eating," so is the result of any test worth while when the actual grower is convinced. Mr. Insley was so convinced that a 4-8-10 mixture was proper that up to July 1, the year following these tests, he had purchased 16 tons of 4-8-10 as compared with none of this particular analysis bought previously.

The Inquiring Mind

(*From page* 16)

in soil drainage and the cultivation, fertilization, and pruning of coffee trees, and tested varieties of oranges, grapefruit, bananas, cacoa and vegetables new to the Island. He studied, likewise, the various types of cigar and cigarette tobacco, and methods of propagating various tropical fruits. The results of his tests and studies were published in the Annual Reports of the Porto Rico Agricultural Experiment Station for the years 1901, 1902, and 1903, and in Bulletin No. 1 he gave an account of the Station, its establishment, location, and purposes.

Early in 1904, Professor Gardner had the Porto Rico work so well organized and the Station equipped with such an able staff of workers that he turned it over to a successor and resumed his work in the U. S. Division of Soils which meanwhile had become a "Bureau." Taking charge of Soil Management, he continued his labors until 1908, and accomplished much by his greenhouse studies of fertilizer requirements of soils of the Central and Eastern States. The results were published in Bulletin No. 48 of the Bureau of Soils.

In 1908 he was appointed head of the Department of Agronomy in the School of Agriculture and Experiment Station of the Pennsylvania State College, for which position he was now splendidly fitted by practical farm work, college training, and extensive experience. Delegating the teaching of soil subjects to a younger man, he devoted his instructional work to farm crops, farm management, farm records and accounts, and farm machinery, and at the same time carried on the experimental work of his Department. So onerous and fatiguing did his duties become that the next year an assistant was employed for some of the farm crop teaching and a few years later the full time of two competent teachers was required. Instructional work in farm management and farm engineering similarly developed and soon required the full time of a teacher in each subject. Later, the duties of the farm-management section were relegated to the newly organized department of Agricultural Economics, and the work in farm machinery to a separate department of Agricultural Engineering. During these periods of development and extension, Professor Gardner was more than fully employed administering his department, directing the teaching

and research staff, conducting personal research studies, teaching a course in the history of agriculture, and holding a weekly seminar for the seniors in agronomy.

The wide range of his undertakings at the Pennsylvania Station is well indicated by the subjects discussed in his many bulletins. They included milling and baking tests, variety tests of oats, the use of lime on land, 50 years' results with fertilizers (with Professor C. F. Noll and C. J. Irvin), the value of limestone of different degrees of fineness (with Professor J. W. White), 40 years' results with fertilizers (with Noll and Lewis, 1922), soil-fertility experiments in Volusia and Westmoreland soils (with White, 1928), soil-fertility drainage of wet land, corn growing and improvement, corn culture, and alfalfa. The Annual Reports of the Pennsylvania State College also presented many other useful papers from his pen, including those on lime and clover (with B. E. Brown) and seed corn conditions in Pennsylvania, 1912. Other scientific papers discussed the solubility of gypsum in aqueous solutions of sodium chloride, the formation of sodium carbonate or "black alkali" by plants, the use of the wire-basket method of soil testing, and liming as related to farm practice.

Despite his multitudinous duties Professor Gardner found time to write texts on soils, farm management, and general agriculture. His most notable publication took the form of an exhaustive treatise and reference book entitled "Successful Farming" brought out in 1916 by the John C. Winston Co. of Philadelphia. It comprised 1,100 pages in 10 books of 80 chapters with 450 illustrations. Half of the "copy" was written by Professor Gardner and he edited the balance, written by 38 prominent authorities and specialists in various agricultural subjects. It was welcomed and approved by a host of eminent agricultural experts. Of it, Professor W. J. Spillman, Chief of the Division of Farm Management, U. S. Department of Agriculture, said: "It is the first general agricultural book for farmers which summarizes our modern knowledge of the subject. The work, in bringing this knowledge together, has been well done."

Professor Gardner also contributed much valuable matter to "Rural Pennsylvania" and "The Book of Rural Life." His extensive travels have taken him into 44 of the 48 States of the Union and to six European countries. He is an expert judge of corn and for many years was one of the principal judges of that grain at the Pennsylvania Corn Show. He also has represented Pennsylvania at some of the National Corn Expositions.

Practical in Every Sense

In 1932 he was elected a Fellow of the American Society of Agronomy, at its June meeting, and chosen as President of the Northeastern Section of that organiaztion. Withal, he is still practical in every sense of the word, for he has for 12 years past operated two farms aggregating 400 acres near State College. There he has had an opportunity to put his scientific knowledge to work and has experienced at first hand all of the vicissitudes of the farmer. He believes, however, that his farms have kept him in close touch with the problems and difficulties of farming, although they may not have added to his financial resources during the lean years of the last decade.

Apart from his Experiment Station work, Professor Gardner has taken an active interest in other directions, being a member of several national organizations among which are the American Association for the Advancement of Science, Biological Society, and the National Geographic Society. He is also president of the University of Illinois Club of the District of Columbia.

E. H. Rohrbeck, Agricultural Editor at Pennsylvania State College, says

of Professor Gardner: "During his 41 years of service in technical agriculture, he has never been without a job and has been employed by only three agencies, viz., four years at his Alma Mater, 13 years in the United States Department of Agriculture, and 24 years with the Pennsylvania State College and Agricultural Experiment Station. His periods of leave have been few and never of more than three months' duration. He is a hard and consistent worker, honest and dependable to the superlative degree, and a man of sound judgment."

Of Professor Gardner, Dr. Ralph L. Watts, Dean and Director of the School of Agriculture and Experiment Station of Pennsylvania State College, writes: "As head of the Department of Agronomy for a quarter of a century, Professor Frank D. Gardner has directed numerous research projects of vital importance to the agricultural industry. His writings, which are unusually clear and concise, reflect thorough knowledge of plant science, farm crops, and soil management problems. His addresses are always helpful and stimulating, whether delivered before college students, scientists, or farmers. His interest in the welfare of agriculture and rural life never wanes. He is a man of high ideals and sterling qualities—an esteemed member of the faculty of Pennsylvania State College."

Yes, "his interest in the welfare of agriculture and rural life *never wanes;*" but now that he is nearing the allotted three-score and ten years in life, he may be getting a bit weary with well-doing, and we wonder whether he does not sometimes long to see again the rolling prairies of the West, hear the meadow-larks and bobolinks singing their cheerful lays, and watch the sun go down in glory.

May his declining years be golden, and his reward the esteem and affection of those for whose best interests he has worked so long and well.

Potash Starvation

(*From page* 12)

have been confused with the virus "streak" disease of tomatoes, also appear in the epidermis of the stems. These have not been observed on cucumber vines at the Ohio Station, but occur regularly on tomato plants. These brown streaks also appear on the leaf petioles and along the larger veins. (See figure 2.)

Tomato and cucumber fruits are also affected by potash deficiency. Tomato fruits usually become dull green in color and angular in shape. They are light in weight, hollow, puffy, blistered, and poorly colored. Often the fruits become blotchy and ripen unevenly, sometimes leaving a hard, green spot on an otherwise well-ripened fruit. The angular, flat-sided appearance is due to the failure of the seeds and the pectin folds which surround them to develop. (See figure 2.) Cucumber fruits fail to develop at the stem end, hence they become gourd-shaped in extreme cases. (See figure 3.)

When the deficiency symptoms of mineral nutrients become so well developed that they may readily be observed by the external appearance of the plants, much damage has already been done to the crop. The addition of soluble fertilizers at this time will help materially to improve the crop, but usually does not compensate for the loss already sustained. The problem in the past has been to detect the approach of mineral deficiencies before they became serious and to apply supplementary fertilizers in time to prevent loss.

Fig. 4—Potash-starved cucumber plants (left) compared with a completely fertilized one (right). Note the chlorotic and dead leaves at the base and the green ones at the top in the potash-starved plants. Note also the absence of lateral branching.

Field tests on living plant material as a whole were unreliable until recently some new ones have been developed which seem to be more satisfactory. The writer has tried the Thornton* field and laboratory tests for phosphorus and potassium needs on living tomato and cucumber plant material. With these tests it was possible to show that few or no potash salts and uncombined phosphates existed in the plants showing the characteristic deficiency symptoms. In another case the tests were used to show that neither of these elements was present in large enough quantities to promote satisfactory growing conditions. This may have been the cause for the poor growth taking place in certain greenhouse vegetable and flower crops that did not yet show unmistakable symptoms of mineral deficiency by the external appearance of the plants.

* S. F. Thornton, State Chemical Department, Purdue University, Agricultural Experiment Station, Lafayette, Indiana.

Nomads and Numskulls

(*From page* 4)

are nicely fired and the oily glow seeps up into the living-room, Thomas settles into his chair and reads newspaper stories about starving and poverty-stricken coal miners living 100 miles west and 150,000 Chicago families standing in line at the public crib to wait for their corn-meal and post-toasties.

No doubt many Indians starved for lack of enough corn in bad seasons, but records do not show that the redskins ever deliberately burned corn as fuel. Charred ears are found in old cooking sites and in burial plots, but even the plains Indians valued corn too dearly to warm their shins by it.

Right here we may pause to see what happened soon after Tonty and his associates succeeded in getting fur-trading posts well established, as this gives us one pioneer clue to the chain of events that brings us up against the "Technocrats." Indians quickly forgot their arts of barbarous life and became dependent upon the trinkets and the implements that the traders brought them. Metal replaced stone; cloth replaced skins; and steel replaced bones and shell. Likewise the life customs of the natives were changed.

In early times the Indian hunted when he required meat for his immediate wants, or skins and bone for his crafts. Agriculture had a firm place in his mixture of work and leisure. But when the fur-traders, the first repre-

sentatives of white laissez-faire, came into his life with the commercial urge and the "gimme" gospel, the poor Indian had to hustle. He penetrated further away from home on long hunting and fur-seeking trips to get goods for the bartering white invader. He neglected his cornfields and his gardens, and idled around the huts of the fur-trader in summer time, drinking and getting mean ideas, only to be off again in the fall to the hunt and the chase. He had tasted super-civilization, and I often think of this when I see some of our Winnebago tribesmen riding out to their blueberry patches in a second-hand Ford. Noble, independent simplicity gone forever!

The Indian had his corn and didn't burn it. He had the land and did not mortgage it. Progress is a queer thing!

NO, the deluded red brother had no economists or statesmen to upset his peace of mind, or interfere with the going value of his products. He was the first standpatter on matters of European entanglements, although G. Washington is more often quoted. He not only "bought American," but he fought American. He had some religious scruples worth dying for, but he never got into class prejudices or mixed his war paint with his wampum.

Returning to the corn plant again, we pause a moment to take stock of our per capita production of that major cereal, although with so much of it going to livestock this is not the proper single comparison. Anyhow, in 1845 just after the Indians gave it to us, we got an average production equal to 25 bushels for every inhabitant. In the last five years we had 20 bushels of corn apiece for the 125,000,000 population. In 1840 Illinois had 45 bushels of corn per capita and in 1930 it had 36 bushels for each of its 7,630,000 people. Folks have outrun fertility. Yet we have to burn the essence of that fertility. Clearly a case approaching closer to under-consumption than over-production, isn't it?

Export has never been much of a direct factor with corn. In 1897 and 1900 when we exported the most corn, our farm prices were 26 cents and 35 cents a bushel, and in 1924 to 1930 when we exported the least, prices stood 65 cents and above. The lore of the Indian corn has spread to Europe, and 12 countries there now grow as much as we did just before the Civil War. We might as well realize that our corn problem is on our own feet. Trying to shift it to foreigners is worse than trying to collect war debts.

THE race that originated corn valued it strictly on its belly-filling propensities in relation to the population. Probably that's what corn was intended for, but later on other valuations got into the picture, owing to a higher state of civilization. The traders who brought a wave of barter and pecuniary greed into the peaceful wilderness were followed by a complex series of price-determining factors that may or may not satisfy all of us that true crop values are reached. Not as long as we still have empty bellies.

Indians did not have to worry about the corn-hog ratio, whether or not it was 11.5 bushels to 100 pounds of pork. Fluctuating future market manipulations were not as familiar to them as the jig dances and gyrations of their medicine men. Whether it has benefited us is still a rousing good debate subject for rural forums. The average corn production in 1930-31 was 2,539,000 bushels less than the corn future deals on six American speculative markets. In 1927 it was 3,826,000 bushels less and in 1924-25 the future bushels exceeded the actual crop bushels by 4,000,000. At the Chicago grain mart for 10 years the future trading represented 50 billion bushels, whereas the entire world output of corn in that same period was

only 42 billion bushels, and for the United States only it was 22 billion bushels.

Neither did such vague terms as the "visible supply" and current business conditions have any effect on the values which our simple precursors placed upon their maize. Visible supply to them simply meant the gladsome tidings that there were a few more kernels to put into the stew pot with the venison, and business conditions signified how good a trade one might make selling a winter's catch of muskrat furs for three-fingers of ould Tom Hennessy or a couple of glass earrings.

But I am nothing if not eminently fair to my own race. There now remain two or three things to be said in favor of our better handling of the food problem, contrasted with the redskins. I do not speak wholly from references, but from actual life among them as an onlooker and for a time as a trader's clerk.

IF any considerable number of wild savages failed in getting their usual crop of corn and all else failed to save them from starvation, they perished. There were no charitable bands of mercy among the Indians. Nature in the raw is seldom mild, as the fag salesmen say. They might feed you to make you riper for the sacrifice, but not for pure generosity or pity. If they had suffered from wide "unemployment" (which like the farmers, they never did) there would have been no bother among the chiefs and sachem councils to find ways of taxing the tribe for the benefit of the unlucky. Social instincts and ideas of humanitarian responsibility came to America with the white race, and thank Heaven, it has survived and outdone the whisky and the skin games.

Similarly, when an Indian gobbled too much parched corn or drank overripe essence of the same article to excess, they let him drop and dug one more grave. We deserve full credit for health building, disease prevention, and warnings to humanity based on scientific study of food in relation to the human body. We haven't been fooling around here just looking for profits—at least not all of us. Let's not spoil that by too close analysis concerning good health and regular employment, however. Let it go as it is—a credit to us for saving each other from poisoning ourselves. There is really something altruistic about it anyhow.

IN addition to the white man's greater social and moral contribution to the balance between food and mankind, as just mentioned, we must also credit Caucasians with more brains and imagination. The Indian was great on a search, but not so hot on research. In the scientific material sense, therefore, white men have utilized the corn crop to an amazing nth degree.

One out of three carloads of corn which arrived at primary markets in recent years was absorbed by the by-products industry. We have corn starch, dextrin, corn oil, corn syrup, corn sugar, and the gluten feeds and meals. Through the mystic powers given to the white race for magical development of new things out of old things, the people consume corn and don't know it. It plays a part in the making of artificial silk, for the nursing of diabetics; in jams, jellies, ice cream, bread, and candy; while crude corn oil wanders off into soap, paint, glycerin, and artificial rubber. Dextrin made from pure corn starch bobs up somehow in fabric finishing, in gums, glues, mucilage, carpets, twine, and even in the fireworks called "sparklers." Corn starch does not cease to "service" folks in pudding and baking powders, but laboratories use it in finishing yarns, in making radio batteries, in cosmetics and pastes, and finally it enters into the explosive industry.

Iowa investigators haven't quit try-

ing to make more and better insulating board out of corn stalks, corn cobs, oat straw, flax straw, licorice root, and amber cane bagasse. Newspapers in the corn belt have been issued on paper made from corn-stalk outer fiber, as well as mixtures of corn stalks and straw and cobs. The white man has found more uses for the maize plant in 75 years than the Indians did in 40 centuries.

Yet the great plant god, Mondamin, revered by the tribesmen, the essence of stored sunshine and the product of human thought and labor, is perhaps the cheapest thing we have at the present time, on the farm. It isn't so cheap in the store package, or on the hotel menu.

WE pick up an emergency circular issued by the Illinois Experiment station, noted for its high-bred strains of Zea Mays and for its conquest of root-rot and ear-blemish diseases, and we see a long dissertation about the best methods of saving what value there is left to the corn ear by the furnace route. Doubtless they have rendered service to Illinois yeomen (now willing enough to be called suckers) by advising them of the relative heating powers of corn and coal. That is not the rub. The nubbin of our argument here is that Illinois is the home state of that pioneer soil experimenter, C. G. Hopkins, and the abiding place of prairie workers who have applied the best mechanical and cultural methods known to science in corn production. Here is the largess of the nation's brimming bread basket emptied into the ash heap right next door to the most abject suffering and hunger. Maybe we had better retire awhile to the wigwam and think it over, get our best medicine men and pow-wow demons busy on the job, and see if we can't correct it. Sure, we have been riding ahead of the forest brethern pretty fast, only we have been dragging our feet!

While legislators and economists are struggling to hatch some scheme for slowing up the natural fountains of agricultural plenty for a year or more, it still remains true that the average individual farmer lays plans for high yield as usual. This rural custom is as old as Adam and has overcome the obstacles of poor soil, weeds, straying livestock, weather, and man's natural laziness. To suddenly stop the process and reverse the gears into crop indifference and negative proposals (in the hopes of raising prices awhile) is something that grates against the sensibility of provident farmers.

So in spite of these official attempts to commit abortion on agriculture, we notice many farmers hereabouts giving thought to the balance left in the soil bank. In the studious years since the Indian abdicated the corn throne, our farmers have learned that crop rotations with legumes and the wise use of mixed fertilizers and special kinds of high analysis fertilizers upon tested soil protects them from any "run" on the soil bank. Even if the land does not produce goods of as great immediate cash value as usual and even if the price return falls temporarily below the cost of the fertility and the labor, not all of this is chargeable to loss. Accumulations of minerals and organic matter in the soil storehouse make any farm just that much more valuable when the time comes that hungry humanity can buy enough variety of the foods and fibers that it craves. Fertility deposits draw interest and no "moratorium" may be placed against them. Only in very unusual cases will the maintenance and restoration of valuables in the soil prove anything but a sane and farsighted policy.

SO when my noble comrade, Pain-in-the-Neck, folds up his blanket and rises to address the Speaker, I know that he is going to say:

"White man have heap corn; white man and squaw and papoose heap hungry; white man heap foolish!"

FUNDAMENTALLY SOUND

On October 23, 1929, the New York Stock Market was smashed down five billion dollars in an avalanche of selling. The day following a large financial house issued the statement that "business is fundamentally sound." Oh! Yeah?

This reminds us of the parody on "Mary's Little Lamb:"

"Mary had a little lamb, its fleece was white as snow; one day she took it to Pittsburgh, and now look at the dam' thing!"—*Exchange.*

1st Negro: "What fo' dat doctah comin' outa youah house?"

2nd Negro: "Ah dunno, but Ah think Ah's got an inkling."

People say that they often find it hard to tell the difference between weeds and young plants. The sure way, of course, is to pull them all out. If they come up again they are weeds. —*Montreal Star.*

Elevator Boy: "Up or down?"

Inebriated (very sick): "Oh, I wish I knew."

Some of our older students give fervent thanks that they lived in the days when you could kiss a girl and taste nothing but girl.

CHECKING UP ON MA

Mother: "Why are you reading that book on the education of children?"

Son: "To see if you are bringing me up properly."—*Bindery Talk.*

BELIEVED IN HIMSELF

Said the teacher to Willie: "Why Willie, what are you drawing?"

"I'm drawing a picture of God."

"But Willie, you mustn't do that; nobody knows how God looks."

Willie smiled confidently: "Well," he said, "they will when I get this done."

Two negro women were discussing present conditions. One of them remarked: "It shuah is too bad, ain't it, that this heah depression had to come jes' when times is so hard."

Bachelor Uncle: "Baby six weeks old, you say. Talk yet?"

Proud Father: "Oh no, not yet."

Bachelor Uncle: "Boy, eh?"

"And why did Noah take two of each kind of animals into the ark?"

"I guess he didn't believe that story about the stork."

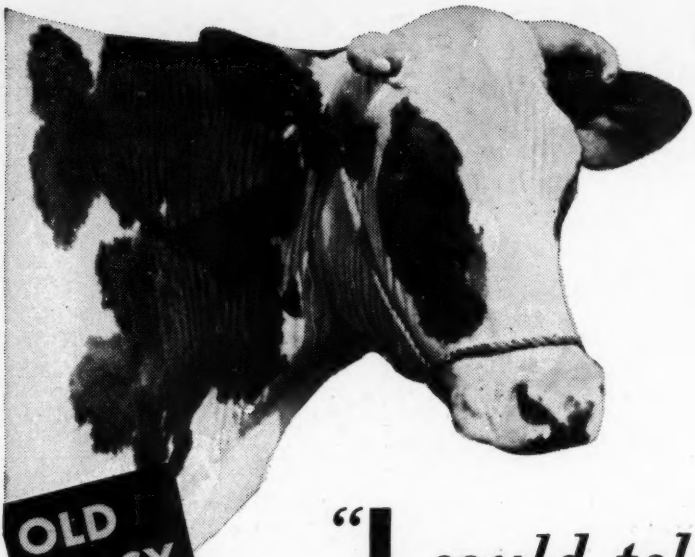
THAT'S O. K.

A woman driver ran into another vehicle and bent a mudguard. It worried her. So she went to a garage and asked the mechanic:

"Can you repair this mudguard so that my husband won't know it has been bent?"

The mechanic looked at the bent mudguard and then at the woman and replied:

"No, madam. I can't. But I can fix it up so that in a few days you can ask your husband how he bent it."



OLD DAISY
pasture expert
SPEAKING:

"I could tell him how to save money"

"When I see the Boss worrying about the feed bill I feel like asking him why he doesn't buy good green feed from his own pasture and save a lot of money. Potato fertilizer would do that pasture of ours a lot of good. We cows help out all we can. All day and half the night we search for good grass, but we have to be fed in the barn to keep us producing. Over at the next farm the cows have it easy. They work only a couple of hours to fill up on fine green feed. Then they rest and their energy is saved to make milk. The farmer over there fertilizes an acre of pasture for each cow with 600 pounds of 4-10-10 potato fertilizer six weeks before he turns out his cows each spring. It's fine for the white clover we cows like so much. I don't see them hauling much store-bought feed over there."

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